Financial Stability in New Zealand:

Three Essays

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Abstract

In this thesis, I explore the past, present, and future of New Zealand's financial stability through the estimation of New Zealand's medium-term financial cycle; a close examination of New Zealand's 1984 currency crisis; and a theoretical consideration of the interaction of monetary policy and macro-prudential policy in pursuit of financial stability outcomes. My results suggest that the nature of the New Zealand financial cycle changed fundamentally after the liberalising reforms of the mid-1980s, leading to greater synchronisation with international capital markets; that the 1984 currency crisis was the result of self-fulfilling market expectations, coordinated by the announcement of a snap election; and that using monetary policy to address financial stability (a policy approach also known as "leaning against the wind") would only be appropriate if the macro-prudential regulator had a low level of risk-sensitivity, and if the macro-prudential instrument is well-tested and known to be effective over the financial stability objective.

Dedicated to my family

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Chapter 1

Introduction

The topic of "financial stability" has been brought to the fore of policymaker concerns by the recent global credit crisis of 2008, when a sharp contraction in global financial markets plunged the world into a deep economic recession. Heightened interest in financial stability, over the following decade, has led to the widespread introduction of "macro-prudential" policies in pursuit of financial stability, alongside a changing focus in monetary and regulatory policy to support this outcome.

New Zealand has been an early adopter of policies in pursuit of financial stability, with subscription to Basel III macro-prudential principals from January 2013, and the introduction of New Zealand's first loan-to-value ratio in the same year. As the core macro-prudential regulator, the Reserve Bank of New Zealand (RBNZ) continues to develop and enhance New Zealand's financial stability, most recently through an ongoing Review of the RBNZ Act that seeks to increase the resilience of the financial system and enhance New Zealand's macro-prudential framework (IMF, 2019).

However, the pace of policy implementation in pursuit of financial stability has outpaced the development of academic theory and practice, both in New Zealand and globally. Most strikingly, the macro-prudential instruments that are ostensibly designed to smooth fluctuations of medium- and long-term financial cycles, have yet to be tested over a complete financial cycle following the 2008 crisis, and little is understood about the nature of financial cycles more generally. In addition, the growing theoretical literature on institutional design for policies in pursuit of financial stability has some shortcomings, such as limited exploration of the role of monetary policy, in supporting macro-prudential policy in the presence of policy uncertainty.

These shortcomings of the current discussion on the nature and pursuit of financial stability form the key motivation for my thesis. Understanding the nature of New Zealand's financial cycle is a first step to informing the design of macro-prudential policy. Additional considerations for New Zealand's past, present, and future financial climate may also yield some insights to the institutional design of New Zealand's broader financial stability response. The history of New Zealand's financial stability, in particular, may yield some insights as to the best institutional design for achieving financial stability going forward. New Zealand has a rich history in financial crises and recoveries, from its first banking crisis in 1895 (Hunt, 2009), to the notable currency crisis of 1984 that marked the beginning of New Zealand's sweeping economic and political "Rogernomics" reforms.

In this thesis, I accordingly explore New Zealand's financial stability by estimating New Zealand's medium-term financial cycle, which can be used to inform macro-prudential policy; identifying the lessons of New Zealand's 1984 currency crisis, which was one of the most influential financial crises in New Zealand's economic history; and exploring the insights of a theoretical model outlining the interaction of macro-prudential policies and traditional monetary policy instruments to achieve first-best financial stability outcomes.

In Chapter 2, I provide the first empirical identification of New Zealand's medium-term financial cycle over the period 1968-2017, which provides an indicator for loosening or tightening time-varying macro-prudential instruments to stabilise prevailing financial conditions. My analysis begins with an index of short-term financial activity that is constructed from a principal component combination of financial indicators, such as credit growth, house prices, and share price indices. I then use spectral analysis (as in Schuler et al., 2015) to identify the length of medium-term cycles within this index, and use a calibrated band-pass filter in the style of Christiano and Fitzgerald (2003) to extract a unique medium-term financial cycle for the New Zealand economy.

My results suggest that the median length of New Zealand's medium-term financial cycle is 8 years, which compares well with international studies such as Aikman et al. (2015) and Schuler et al. (2015). The results also suggest that the duration of New Zealand's medium-term financial cycle has increased substantially, following the economic and political reforms of the mid-1980s, from a pre-1986 length of 4.75 years, to a post-1986 length of 9.75 years, while the volatility of New Zealand's financial cycle simultaneously decreased. These findings imply that the liberalising reforms of the mid-1980s — which opened New Zealand's external account, and led to greater integration with international capital markets — lengthened and softened the severity of New Zealand's financial booms and busts.

I also compare the key characteristics of New Zealand's financial cycle against the characteristics of New Zealand's business cycle, and against the financial cycle in the United States (US). I find a strong relationship between financial cycle contractions and real economic contractions, as 83% of New Zealand's recessions are preceded by a financial cycle contraction, by a median 2.5 years. I also find that the degree of synchronisation between the New Zealand and US financial cycles has increased following the mid-1980s reforms, further reflecting the impact of internationalisation on New Zealand's financial and capital markets.

In Chapter 3, I expand my consideration of New Zealand's financial stability by exploring one of New Zealand's most influential financial crises — namely, the 1984 currency crisis, which marked the beginning of the mid-1980s liberal reforms that transformed New Zealand into one of the most open economies in the world. This currency crisis was the result of a complex interplay of short- and long-term factors, although the origins of the crisis have not yet been explored by academics through the lens of the theoretical literature on currency crises.

I consider the origins of New Zealand's 1984 currency crisis by hand-collecting a dataset from the 1954-85 RBNZ bulletins and using this data to inform a summary on the short- and long-term economic factors affecting New Zealand's external account. I then compare these factors against the narratives of key theoretical models, which allows me to draw conclusions from the theoretical literature, and thereby shed some light on how the institutions and financial policies of the relevant policymakers can shape financial conditions in New Zealand.

The factors that led to the 1984 currency crisis included a chronically overvalued exchange rate — partially on account of domestic lobbying groups, which resisted nominal devaluation due to importing interests — as well as rising government debt and a lack of access to international lending to support the continuation of New Zealand's fixed exchange rate regime. The crisis itself occurred after the announcement of a snap election by the incumbent Prime Minister Muldoon, and resulted in a 20% devaluation of the New Zealand dollar on the 18$^{\text{th}}$ July immediately following the election of the incoming Prime Minister Lange.

I find that this experience most closely aligns with Obstfeld's (1994) model of self-fulfilling expectations, where speculators on New Zealand's international account can create the currency crisis that they expect to see, as well as Rother's (2009) model, where an upcoming political election coordinates speculators to expect a crisis at the same time, and thereby attack New Zealand's currency simultaneously. The narrative also bears some similarities to models of information contagion, as prior decisions made by the New Zealand government over the external account closely mirrored those made by the contemporary Australian government. New Zealand speculators expected to see a currency crisis emerge in response to the snap election in 1984, as a similar crisis emerged in March 1983 in response to the Australian snap election.

Finally, in Chapter 4, I evaluate the efficacy and institutional design of macro-prudential policy, and ask how these factors can impact the appropriateness of "leaning against the wind" as a framework for addressing financial stability. Using monetary policy instruments to lean against the wind is often seen as a substitute for macro-prudential policy, as in Smets (2014). This means that leaning against the wind by the monetary authority allows the macro-prudential regulator to reduce the extent of their restrictions. However, this arrangement may result in sub-optimal *ex-ante* financial conditions if the macro-prudential regulator subsequently loosens their restrictions too much. I seek to specifically identify the conditions under which leaning against the wind will result in sub-optimal outcomes.

I combine the institutional framework of Smets (2014) with the macro-prudential efficacy framework of Bahaj and Foulis (2017), who outline two potential distortions over the macro-prudential regulator: instrument uncertainty and model uncertainty. Instrument uncertainty describes a weak causality between macro-prudential instruments and financial stability outcomes, where — as in the classic Brainard (1967) model of policy uncertainty — greater instrument uncertainty causes the macro-prudential authority to become less responsive to changes in financial conditions. Model uncertainty meanwhile describes a macro-prudential regulator with an incorrect or poorly designed model of prevailing financial conditions, which — as in the case of Knightian uncertainty explored by Hansen and Sargent (2001) — causes the macro-prudential regulator to be overly responsive when selecting macro-prudential restrictions.

In combining these theoretical elements of macro-prudential and monetary policy, I find that using a monetary instrument to lean against the wind and address financial stability will only improve the macro-prudential policy rule if the impact of model uncertainty is stronger than the impact of instrument uncertainty.

In the construction of this model, the extent of model uncertainty is inversely proportional to the "risk-sensitivity" of the macro-prudential regulator, which means that leaning against the wind will only be justifiable if the macro-prudential regulator has a low level of sensitivity.

Chapter 5 concludes, with relevant insights for New Zealand policymaking in pursuit of financial stability.

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A version of Chapter 2 (The New Zealand Financial Cycle: 1968-2017) has been published as Davies, C., and Gai, P. (2020) "The New Zealand Financial Cycle 1968-2017," with New Zealand Economic Papers, Vol. 54(1), pp. 1-15.

Nature of contribution by PhD candidate	Designed and conducted the analysis/estimation; wrote the paper.
Extent of contribution by PhD candidate (%)	75

CO-AUTHORS

Name	Nature of Contribution
Prasanna GAI	Suggested the topic and approach; helped interpret the findings and draft the manuscript.
Caitlin DAVIES	Designed and conducted the analysis/estimation; wrote the paper.

Certification by Co-Authors

The undersigned hereby certify that:

- the above statement correctly reflects the nature and extent of the PhD candidate's contribution to this work, and the nature of the contribution of each of the co-authors; and
- that the candidate wrote all or the majority of the text.

Name	Signature	Date
PRASANNA GAI		12 July 2020
CAITLIN DAVIES		12 July 2020

Chapter 2

The New Zealand Financial Cycle: 1968-2017

2.1 Introduction

The global financial crisis has renewed interest in understanding financial cycles and their implications for the real economy.[1] The Bank for International Settlements (BIS) has forcefully articulated the role of investors' risk appetite in driving booms and busts in credit and asset prices (Borio, 2012). Recent work by Reinhart and Rogoff (2009), and Jorda, Schularick, and Taylor (2015) also suggests that strong credit growth and house price booms are good predictors of crises and significantly shape macroeconomic out-turns. The resulting international debate has had important consequences for financial stability policy design – for example, policymakers have increasingly sought to implement macro-prudential instruments in an effort to "fine-tune" the financial cycle.

[1]A version of this chapter, co-authored with my supervisor Prasanna Gai, has been published as the lead article in New Zealand Economic Papers, Vol. 51(1), pp. 1-15 (Davies and Gai, 2020). This chapter has also been presented at the Annual Conference of the New Zealand Association of Economists, Wellington, 3rd July—5th July 2019, and in seminars within the Department of Economics at the University of Auckland. I am thankful to Anthony Endres, Ryan McGreenaway-McGrevy, and Tim Ng for their valuable comments on draft versions of this chapter. I am also thankful for the useful comments of two anonymous journal referees.

New Zealand has been an early adopter of macro-prudential policies, but although there has been some discussion of how financial variables can help measure financial stability (Hunt, 2013), there has been no formal attempt to construct a financial cycle for New Zealand and explore its characteristics. By contrast, a growing literature studies financial cycles in the US, the UK, and the Euro area (e.g. Aikman, Haldane, and Nelson, 2015; Drehmann, Borio, and Tsatsaronis, 2012; Stremmel, 2015; Strohsal, Proano, and Wolters, 2017),while Claessens, Kose, and Terrones (2011) describe the features of financial cycles from a panel study of 21 OECD countries.

In this chapter, I document the New Zealand financial cycle over the 50-year period 1968–2017. My purpose is to assemble stylised facts about general financial conditions in New Zealand with a view to informing academic and policy debate on financial stability policy. The approach I adopt is to consolidate financial variables into a single measure (a "financial conditions index") using the method of principal components. I then use spectral analysis and frequency-based band-pass filters to extract a financial cycle from the index and describe its characteristics. I also explore the extent to which the New Zealand financial cycle is linked to the New Zealand business cycle and a similarly constructed US financial cycle.

Although my results are a tentative first step, they shed some light on the extent of financial and real synchronisation in New Zealand, and the important effect that the global financial cycle highlighted by Rey (2016), Miranda-Agrippino and Rey (2015), and Bruno and Shin (2015) can have on a small open economy. Specifically, I find that financial cycles in New Zealand are much longer than the typical business cycle, that the extent of synchronisation between the cycles is considerable, and that the relationship between real and financial variables shows signs of changing after 1986. In addition, while the US and NZ financial cycles are broadly similar on average, the synchronisation between the cycles increases markedly after 1986. These findings seem to confirm the importance of financial factors and spillovers from the global financial cycle reported elsewhere in the literature.

The broad characteristics of the New Zealand financial cycle seem comparable to financial cycles documented for other advanced economies. It has a median length of around 8 years and its duration increases after 1986. The overall impression is that the New Zealand financial cycle has become longer and slower over time, as international financial integration has assumed greater significance. My measure of the financial cycle also appears to be broadly consistent with the major economic developments in New Zealand during this period, notably the first oil price shock, the financial crisis of 1984, and the Asian and global financial crises.

2.1.0.1 Related Literature

This chapter builds on the recent empirical literature on financial cycles. Claessens et al. (2011) study a sample of 21 OECD countries over the period 1960–2007 using the turning point method of Harding and Pagan (2002) to explore the duration and amplitude of financial cycles, the extent to which these cycles are synchronised across countries, and whether downturns in financial cycles lead to downturns in real activity. Their results, echoed in the subsequent literature, suggest that financial cycles are longer than business cycles, are synchronised across countries, and play an important role in economic downturns. Drehmann et al. (2012) is another key contribution that reaches similar conclusions, and brings a medium-term focus to the financial cycle literature through the use of frequency filter methods developed by Comin and Gertler (2006).

Subsequent papers introduce spectral analysis to the analysis of financial cycles. Aikman et al. (2015) apply univariate spectral analysis to study the US credit cycle, while Strohsal et al. (2017) and Schuler, Hiebert, and Peltonen (2015) use multi-variate spectral analysis to examine financial cycles in the US and UK, and the Euro area. Cagliarini and Price (2017) also draw on the method to study the Australian credit and business cycles. As with my analysis, some of these papers (notably Claessens et al., 2011; Strohsal et al., 2017) suggest that greater global capital market integration during the 1980s may have altered the nature of the financial cycle – while the cycle length of a typical financial cycle before 1985 was around 6 or 7 years, this extends to almost 15 years after 1985.

My approach of aggregating financial variables into a single index is also used by Drehmann et al. (2012), Stremmel (2015), Einarsson, Gunnlaugsson, Olafsson, and Petursson (2016), and Krznar and Matheson (2017). Principal component analysis of financial conditions indices facilitates univariate spectral analysis and band-pass frequency isolation and is used by Hatzius, Hooper, Mishkin, Schoenholz, and Watson (2010) and Domanski and Ng (2011) among others.

2.2 Constructing a Financial Cycle for New Zealand

I construct the financial cycle by aggregating a group of financial variables into a single financial conditions index using principal components analysis. I then use spectral analysis to identify cycles in the index and band-pass filter methods to isolate cycle frequency. Finally, I draw out some key features of the financial cycle.

2.2.0.1 Financial Conditions Index

The principal components approach captures the extent to which a group of financial variables is correlated with a common underlying factor, which I interpret as reflecting the general level of financial activity in the economy. The method assigns a weighting to each variable which explains the highest amount of variation in the common factor (Campbell, Lo, and MacKinlay, 1997). I focus on the first principal component in what follows.

Appendix A describes the data used to construct the financial conditions index, and Appendix C describes the data sources. The nine variables used for the index are: real credit; the credit/GDP ratio; real money (M3); the ratios of M3/GDP and credit/M3; gross capital formation in housing/GDP; real house prices; real equity prices; and the spread between mortgage interest rates and six-month deposit rates. Since stationarity is essential for spectral analysis, the variables are adjusted to year-on-year percentage changes.[2] The variables are also normalised by standard deviation to facilitate comparability.

Tables 2.1 and 2.2 present the results of the principal components analysis for the entire sample, the pre- and post-1986 periods, and by decade. The choice of 1986 is relevant for New Zealand since it marks a period of major economic reform and integration with the global economy, with the Reserve Bank of New Zealand Amendment Act 1986, deepening ties to Australia through the progression of Closer Economic Relations, and the delayed impact of floating the New Zealand dollar in March 1985. Consistent with this, an Augmented Dickey-Fuller break-point unit root test on the financial conditions index reveals a statistically significant structural break at 1986 Q3, with a p-value of 0.04 (Dickey and Fuller, 1979, 1981).[3] There are no other statistically significant structural breaks within the New Zealand financial conditions index.

The first column of Table 2.1 estimates an unrestricted first principal component of financial activity in New Zealand, where each entry corresponds to the weighting of that variable in the calculation of the financial conditions index. Real money, M3/GDP, and the interest rate spread are restricted from the further iterations of the principal component analysis, as they do not have a strong correlation with

[2] I take the yearly difference of the interest spread due to extreme outliers when using annual percentage changes.

[3] Evans, Grimes, Wilkinson, and Teece (1996) provide an extensive and useful breakdown of the reforms and surrounding events of the mid-eighties. The structural break as calculated here can be seen as the average impact of these reforms on each of the underlying variables that comprise the financial conditions index.

	Unrestricted	Restricted		
	1960-2017	1960-1986	1986 - 2017	1960 - 2017
Real Credit	0.54	0.53	0.58	0.54
Credit-to-GDP	0.44	0.43	0.53	0.45
Real Money	0.08	-	-	-
Money-to-GDP	-0.08	-	-	-
Credit-to-Money	0.47	0.48	0.47	0.48
GCFH-to-GDP	0.25	0.34	0.05	0.24
House Price Index	0.36	0.34	0.21	0.36
Stock Price Index	0.30	0.25	0.32	0.30
Interest Rate Spread	-0.00	-	-	-
Explained Variance	0.34	0.54	0.43	0.51

Table 2.1: Principal components analysis.

the common element of the unrestricted first principal component. The remaining three columns of Table 2.1 show the six variables chosen for the index: real credit, credit/GDP, credit/M3, real house prices, real equity prices, and gross capital formation in housing/GDP. The financial conditions index is calculated from the second column of Table 2.1, which is the restricted weighting for 1960–2017.

In the unrestricted model, the linear combination of all nine variables explains 34% of the variation in the principal component. In the restricted models, the linear combination of the remaining six variables explains 51% of the variation in the principal component across the full range of 1968–2017, 54% of the variable in the principal component across the range of 1968–1986, and 43% of the variation in the principal component across the range of 1986–2017.

Table 2.2 provides a decade-by-decade principal component for the six restricted variables. A noteworthy feature of the decade-by-decade analysis is that the weight accorded to the gross capital in housing formation/GDP ratio falls sharply in the decades 1985–94 and 2004–15. A similar sharp decline in the weight on equity prices during 2004–15 may reflect the adverse impact of the global financial crisis

	Restricted				
	1965-1974	1975-1984	1985-1994	1995-2004	2005-2015
Real Credit	0.52	0.50	0.55	0.58	0.56
Credit-to-GDP	0.37	0.41	0.53	0.44	0.55
Credit-to-Money	0.45	0.48	0.51	0.33	0.50
GCFH-to-GDP	0.35	0.40	-0.10	0.18	-0.14
House Price Index	0.50	0.26	0.13	0.36	0.33
Stock Price Index	-0.14	0.35	0.36	0.45	0.06
Explained Variance	0.54	0.59	0.50	0.42	0.49

Table 2.2: Principal components decade-by-decade analysis.

on the share market and financial conditions more generally.

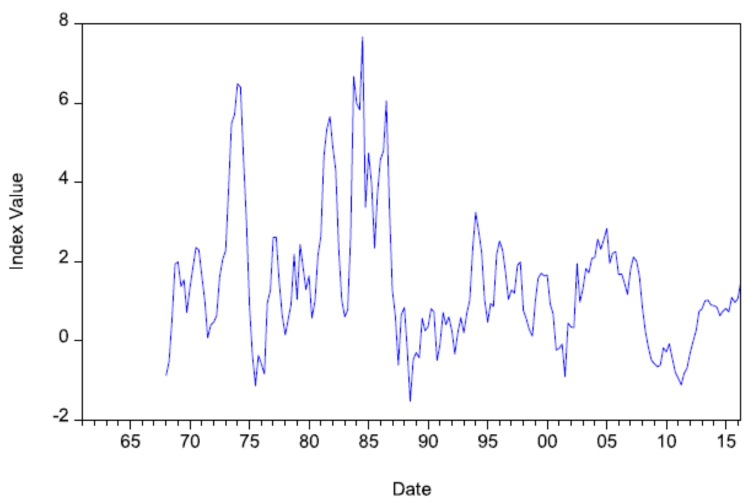

Figure 2.1: New Zealand Financial Conditions Index 1968-2017

Figure 2.1 presents the unfiltered financial conditions index over the fifty-year period 1968 Q1 to 2017 Q1 based on a balanced panel of data and the restricted weightings in the principal components analysis. The financial conditions index shows a marked decline in volatility after the 1986 structural break, which might reflect better risk-sharing with the rest of the world following the removal of capital controls and exchange rate restrictions.

2.2.0.2 Spectral Density Analysis and Cycle Extraction

I next consider how common a certain cycle length is within the data by using spectral analysis (for a more detailed description, see Hamilton, 1994). The auto-correlation of a dataset $\gamma(h)$ measures the extent to which the dataset is correlated with itself. The Fourier transformation of this auto-correlation yields the power spectrum $P_x(f)$ that represents the frequency, f, of the dataset across time relative to itself. The frequency of the dataset can be seen as the number of cycles that are observed per period, and the resulting power spectrum is given by,

$$P_x(f) = \sum_{k=-\infty}^{\infty} e^{-2\pi i f h}$$

where f is the frequency of the dataset, $i = \sqrt{-1}$, γk is the auto-correlation of the time series, and $\{X(t); t \in (-\infty, \infty)\}$ is a stationary time series. Normalising the power spectrum by the variance of the dataset, σ_x^2, yields the spectral density,

$$S_x(f) = \frac{\sum\limits_{k=-\infty}^{\infty} e^{-2\pi i f h}}{\sigma_x^2} = \sum_{k=-\infty}^{\infty} e^{-2\pi i f h} \rho k$$

Spectral analysis returns a periodogram that shows the number of cycles that have been identified at each period length. For smoothing purposes, it is subject to a truncation point that limits the length of time that is being observed. The truncation point $M = 2\sqrt{n}$, where n is the time length of the dataset, is typically chosen to avoid over- or under-sensitive cycle identification. I smooth the periodogram by setting $M = 30$ and use the Bartlett-Priestley kernel to allow for the construction of a 95% confidence interval around the mean of each frequency.

Figure 2.2 presents the spectral density of the financial conditions index. The x-axis represents the length of a potential cycle that can be found within the data. The left-hand side of the x-axis corresponds to longer cycle durations, while the right-hand side corresponds to shorter cycle durations. Cycle length can be calculated from the graph by inverting this value; for example, x-axis value

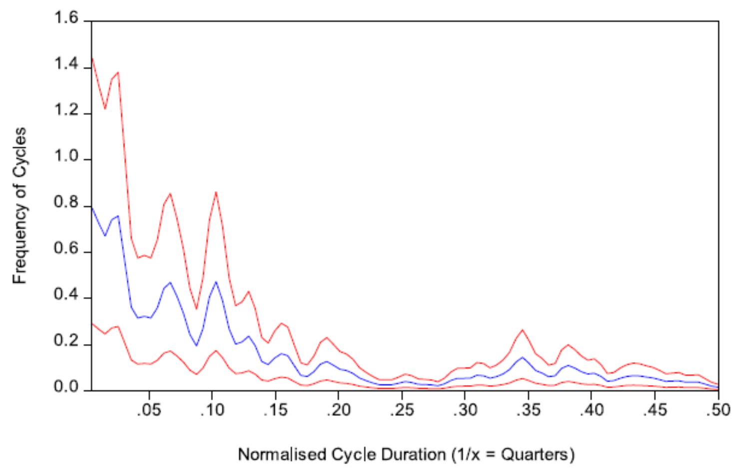

Figure 2.2: Spectral Density of the New Zealand Financial Conditions Index

$\frac{1}{0.15} = 6.66$ quarters. The y-axis represents the spectral density corresponding to each frequency, i.e. it measures how often a cycle of the corresponding length appears in the data. The blue line measures the commonality of a certain cycle length and the red bands correspond to the 95% confidence interval.

The flattening of the spectrum at 0.25 suggests that there are very few cycles that are one year in duration. The hump in spectral density to the right, between 0.25 and 0.5, reflects cycles that occur within a year and can be viewed as noise. To the left of 0.25, cycles are of a duration longer than a year. Figure 2.2 highlights three significant peaks in the spectral density for the financial conditions index: one at 0.025, a second at 0.06, and a third at 0.103. These correspond to cycles of 10 years, 4.2 years, and 2.5 years respectively. The peak in the spectral density against the left-hand axis shows that there is a strong degree of persistence in the financial conditions index, which may be a result of the structural break at 1986 Q3.

The appropriate choice of length for a medium-term cycle from Figure 2.2 is not immediately apparent. Although the most common medium-term cycle length is 10 years, this calibration for the minimum length of the financial cycle would necessarily exclude any medium-term cycles which are shorter than this frequency. I therefore consider the range of cycle durations across the first 'hump' to the left of 0.25. Thus, when calibrating the band-pass filter, the medium-term cycle of the index ranges from a maximum length of 50 years to a minimum length of 4.75 years. The cycle duration in this analysis is comparable with the results of spectral analysis elsewhere in the literature. Analyses of UK and European financial cycles suggest common cycle lengths of 11 years (Aikman et al., 2015) and 7.2 years (Schuler et al., 2015), and a minimum cycle length of 4.5 years (Schuler et al., 2015).

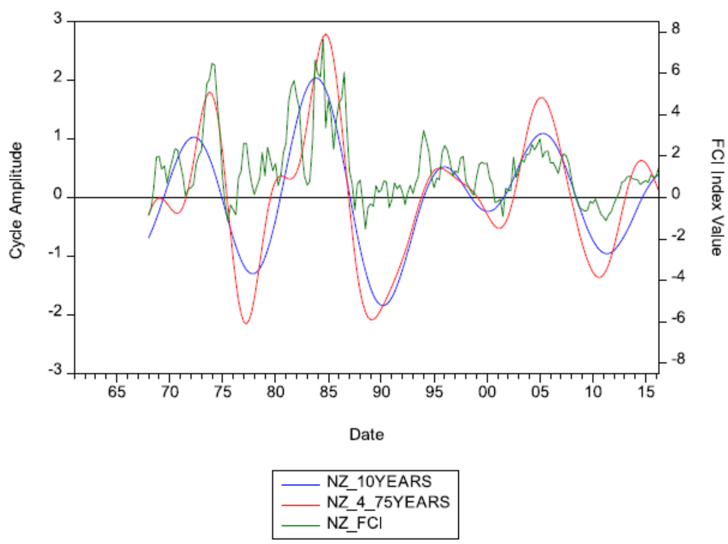

Figure 2.3: Short- and Long-Term Financial Cycles and the Financial Conditions Index

I use the Christiano and Fitzgerald (2003) band-pass filter to extract cycles from the time series of the financial conditions index. A cycle length of between 8 and 30 years is often described as the range for the length of the financial cycle in the literature, while cycles of between 2.5 and 8 years are typical of the length of the business cycle. Drawing on spectral analysis, I extract two cycles: a long cycle of 10 years, and a shorter cycle of 4.75 years. These two financial cycles are shown in Figure 2.3. The vertical axis captures the amplitude of the cycle, and the horizontal axis the time interval. I base my analysis on the shorter cycle for the remainder of this chapter to facilitate comparisons with the business cycle in New Zealand.

2.2.0.3 Stylised Facts

Phase	Phase Duration (Quarters)	Cycle Duration (Years)	Amplitude	Slope
(exp.) —1969 Q1	>5		—	—
(con.) 1969 Q1—1970 Q4	7		-0.26	-0.03
(exp.) 1971 Q1—1973 Q4	12	4.75 Years	2.07	0.17
(con.) 1974 Q1—1977 Q2	14		-3.96	-0.28
(exp.) 1977 Q3—1980 Q3	13	6.25 Years	2.52	0.19
(con.) 1980 Q4—1981 Q3	4		-0.05	-0.01
(exp.) 1981 Q4—1984 Q4	13	4.25 Years	2.47	0.19
(con.) 1985 Q1—1989 Q1	17		-4.87	-0.28
(exp.) 1989 Q2—1995 Q3	26	10.5 Years	2.59	0.09
(con.) 1995 Q4—2000 Q1	23		-1.03	-0.04
(exp.) 2000 Q2—2005 Q2	16	9.75 Years	2.23	0.13
(con.) 2005 Q3—2010 Q3	21		-3.07	-0.14
(exp.) 2010 Q4—2014 Q3	16	9.25 Years	1.99	0.12
(con.) 2014 Q4—	>7		-	-
Total Median	3.75 Years	8 Years	2.26	0.14
Pre-1986 Median	3.125 Years	4.75 Years	2.27	0.18
Post-1986 Median	4.75 Years	9.75 Years	2.41	0.13

Table 2.3: Characteristics of the New Zealand financial cycle. Expansionary phase = exp.; Contractionary phase = con.

Table 2.3 documents the duration, amplitude, and slope of the expansion and contraction phases of the financial cycle. The duration is measured as the number of quarters from each peak to the subsequent trough for each contraction, and vice versa for each expansion. The amplitude is the percentage change from trough to peak (expansions) or peak to trough (contractions). The slope measures the volatility of the cycles phase and is the ratio of amplitude and duration.

Over the 50-year period under consideration, the financial cycle has a median length of 8 years. I find that the shortest financial cycle is 4.25 years in length, and the longest is 10.5 years. The length of the financial cycle in New Zealand is comparable to the findings reported in Schuler et al. (2015), who suggest that the average length of a financial cycle in 13 EU countries is around 7.2 years and the duration of the shortest cycle is around 4.5 years. Expansions in the New Zealand financial cycle are on average slightly longer than the duration of contractions (an average duration of 16 quarters for expansions, as compared to 14.33 for contractions), slighter steeper (an average slope of 0.15 as compared to 0.13) and slightly more volatile (an average amplitude of 2.31 as compared 2.21).

The duration of the financial cycle in New Zealand appears to have increased since 1986, from an average of 4.75 years to 9.75 years. This is consistent with results reported by Claessens et al. (2011) and Drehmann et al. (2012). Although the post-1986 period points to an increase in the amplitude of the cycle, once the duration of the cycle is taken into account, the slope measure suggest that cyclical volatility has decreased over time. The financial cycle appears to have become longer and slower over time, perhaps reflecting the increased financial integration of New Zealand into the global economy.

2.3 Financial and Business Cycles in New Zealand

Figure 2.4 plots the financial cycle against recessions (shaded) in New Zealand identified by Hall and McDermott (2016). Of the six contractionary episodes during the past 50 years, five occur less than three years after a peak in the financial cycle.[4] The median lag from each financial peak to the subsequent Hall-

[4]The exception is the contraction between 1991 Q1 and 1991 Q2 which, at two quarters, just qualifies as a technical recession.

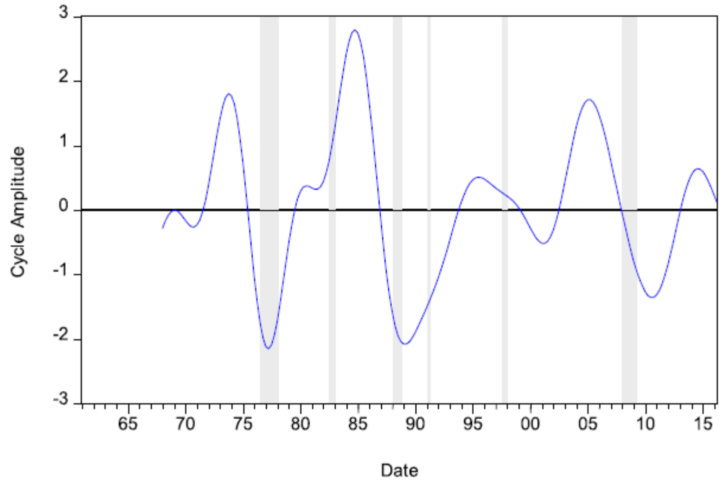

Figure 2.4: New Zealand Financial Cycle and Recessions

McDermott recession is 2.5 years. Table 2.4 summarises the close relationship between the financial cycle and the Hall-McDermott recessions, as 83% of New Zealand recessions are preceded by financial cycle contractions by a median of two and a half years.

Hall-McDermott Contraction	Lag from Previous Financial Peak
1976 Q3 — 1978 Q1	11 Quarters
1982 Q3 — 1983 Q2	8 Quarters
1988 Q1 — 1988 Q4	13 Quarters
1991 Q1 — 1991 Q2	-
1997 Q3 — 1998 Q1	8 Quarters
2008 Q1 — 2009 Q2	10 Quarters
Median Lag	10 Quarters (2.5 Years)

Table 2.4: The New Zealand financial cycle and Hall-McDermott recessions.

As a final step, I draw on spectral analysis of real GDP growth to provide additional insight into the New Zealand business cycle and to contrast it with the New Zealand medium-term financial cycle. Figure 2.5 shows the spectral density for real GDP growth. In contrast to the financial conditions index, there are fewer

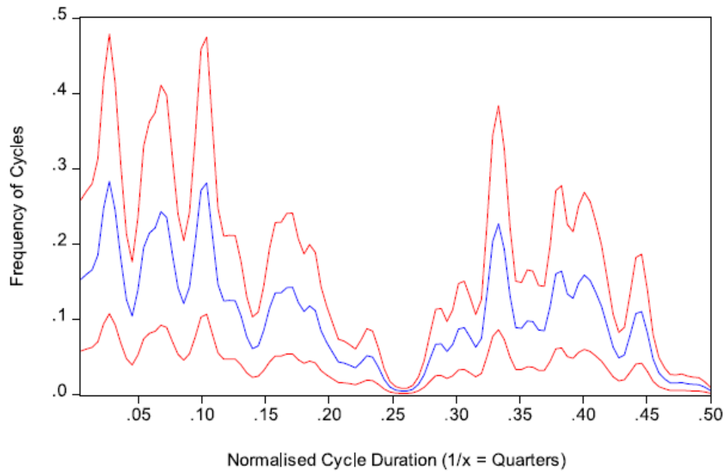

Figure 2.5: Spectral Density of New Zealand Real GDP Growth

medium term cycles and more short-term cycles. The medium-term cycles lie to left of 0.25 (the one-year cycle). Cycles to the right of 0.25 are very-short term in duration and are less than a year in duration. These can be considered to be noise.

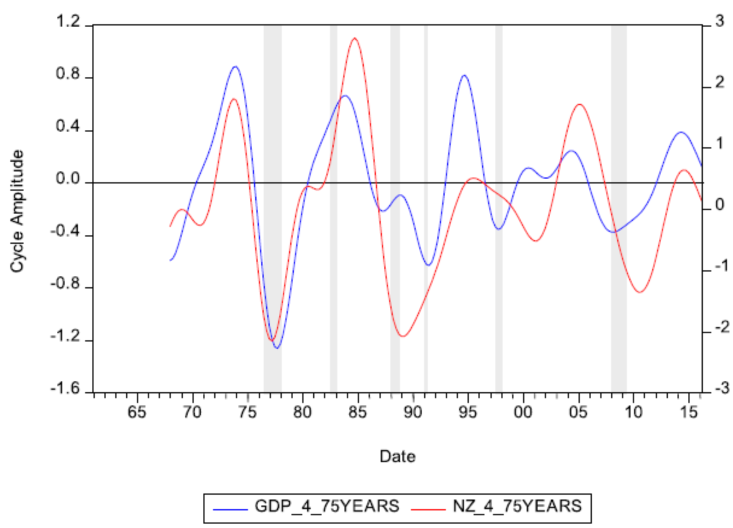

Figure 2.6: The New Zealand Financial Cycle and Business Cycle

Figure 2.6 extracts a cycle from the real GDP data using a band-pass filter calibrated to a minimum length of 4.75 years per cycle to facilitate real comparison with the financial cycle. As can be seen, the business cycle has more frequent fluctuations which generally coincide with financial cycle fluctuations. Business cycle contractions largely coincide with the recessions identified by Hall and McDermott (2016). Table 2.6 summarises the amplitude, duration and slope of business cycle expansions and contractions. These results suggest that the business cycle has an average length of 5.9 years — much shorter than the financial cycle average of 8 years, despite being calculated using the same calibration.

	Total (%)	Pre-1986 (%)	Post-1986 (%)
NZ Financial and Business Cycles	73.71	86.5	66.4
NZ FCI and GDP	60.82	48.61	68.03

Table 2.5: Concordance analysis of New Zealand's financial and business cycles.

Concordance analysis reveals the degree of synchronisation between cycles by calculating the percentage of quarters in which the cycles are in the same phase (i.e. both expanding or both contracting), as in Stremmel (2015). Table 2.5 indicates that the medium-term New Zealand financial and business cycles (as estimated within this chapter) were in sync 73.71% of the time between 1968 and 2016, with a declining concordance rate after 1986 suggesting that the NZ financial cycle may have become less synchronised with the business cycle over the latter part of the time period. The short-term data for New Zealand financial conditions and New Zealand GDP reveal a lower concordance percentage, and an increasing concordance before and after 1986. These results suggest that while medium-term trends are becoming less synchronised in New Zealand, short-term fluctuations are becoming relatively more synchronised.

The New Zealand business cycle appears to have become shorter following 1986, with the median duration falling from 10 years to 5.75 years (see Table 2.6). The amplitude and the slope of the business cycle derived from the spectral analysis

		Phase Duration	Cycle Duration	Amplitude	Slope
Financial Cycle	1968-2017	3.75 Years	8 Years	2.26	0.14
	Pre-1986	3.125 Years	4.75 Years	2.27	0.18
	Post-1986	4.75 Years	9.75 Years	2.41	0.13
Business Cycle	1968-2017	3.125 Years	5.875 Years	0.69	0.05
	Pre-1986	4 Years	10 Years	2.04	0.11
	Post-1986	2.875 Years	5.75 Years	0.58	0.04

Table 2.6: Median characteristics of the New Zealand financial and business cycles.

also fall after 1986. The volatility of both financial and business cycles is lower after 1986.

2.4 Synchronisation with the US Financial Cycle

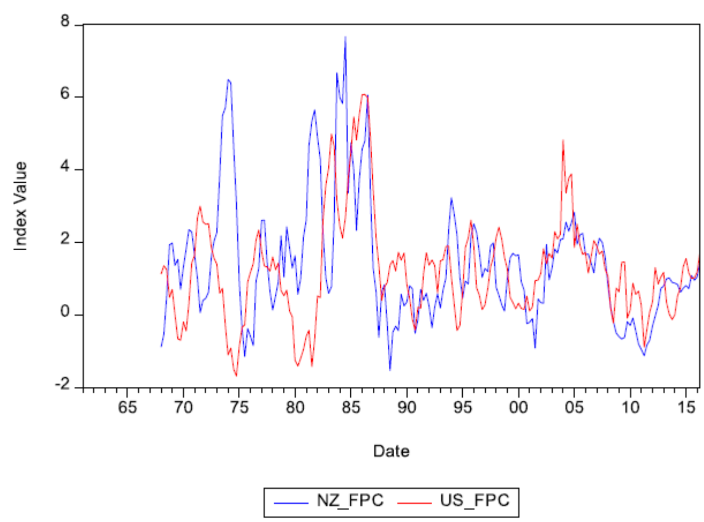

Figure 2.7: The New Zealand and US Financial Conditions Indices

Recent work by Rey (2016) and Jorda et al. (2015) suggests that synchronisation of financial cycles across the advanced economies has become increasingly prevalent, reflecting the important role that US monetary policy plays in transmitting fluctuations in risk appetite across global equity markets. I therefore investigate the extent to which the financial cycle in New Zealand is synchronised with the financial cycle in the US to gauge the potential importance of this channel. My approach to constructing a US financial cycle is the same as before: I construct a financial conditions index using principal components analysis, and then study the characteristics of the cycle derived from spectral analysis and the band-pass filter. The choice of variables for the US financial conditions index is similar to the one for New Zealand. Details of the variables used are provided in Appendix B, while Appendix C describes the data sources.

	Restricted US 1960-2017	Restricted NZ 1960-2017
Real Credit	0.67	0.54
Credit-to-GDP	0.53	0.45
Credit-to-Money	0.25	0.48
GCF-to-GDP	0.35	0.24
House Price Index	0.03	0.36
Stock Price Index	0.30	0.30
Variance Explained	0.32	0.51

Table 2.7: Principal components analysis for US and NZ financial conditions indices.

Table 2.7 reports the results of the principal components analysis, and shows that the house price index is poorly correlated with the common financial factor. Moreover, the US unrestricted principal component explains only 32% of the variation in the common factor. In order to facilitate analysis with the New Zealand index, I nevertheless retain US real house prices in the US financial index. Figure 2.7 presents the unfiltered indices for both countries.

Figure 2.8 presents the results of a spectral analysis on the US financial conditions index. It suggests that the most common cycle length is at the frequency 0.02, which is 11 years. The trough of the first 'hump' corresponds to a cycle duration of 17 quarters, i.e. 4.25 years. Accordingly, I apply the same cycle duration on the US index as the New Zealand index, namely that the medium-term financial

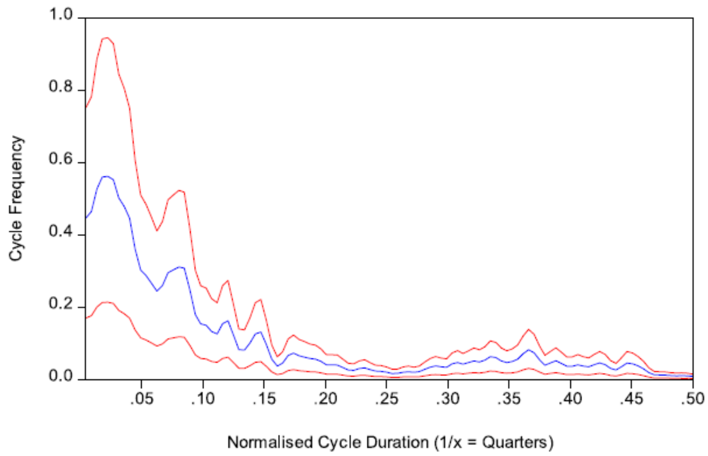

Figure 2.8: Spectral Density of US Financial Conditions Index

cycle is between 4.75 and 50 years for comparability. Table 2.8 reports the cycle characteristics of the US cycle as compared to the characteristics of the New Zealand cycle. These results suggest a median duration of the US financial cycle of 7.125 years, a result that is comparable to other results that find an average duration of 7.2 years (Schuler et al., 2015).

		Phase Duration	Cycle Duration	Amplitude	Slope
US Financial Cycle	1968-2017	3 Years	7.125 Years	2.29	0.16
	Pre-1986	3 Years	6.75 Years	3.11	0.26
	Post-1986	3.25 Years	7.125 Years	1.21	0.09
NZ Financial Cycle	1968-2017	3.75 Years	8 Years	2.26	0.14
	Pre-1986	3.125 Years	4.75 Years	2.27	0.18
	Post-1986	4.75 Years	9.75 Years	2.41	0.13

Table 2.8: Median characteristics of the New Zealand and US financial cycles.

Figure 2.9 and Table 2.9 compare the US and New Zealand financial cycles of the same 4.75 year calibration. These results highlight a very different response to the global financial crisis of 2007/8. New Zealand experienced a period of decreased financial activity during this period, as credit and related variables in the index declined. The US financial cycle contraction, by contrast, is more stilted and has a

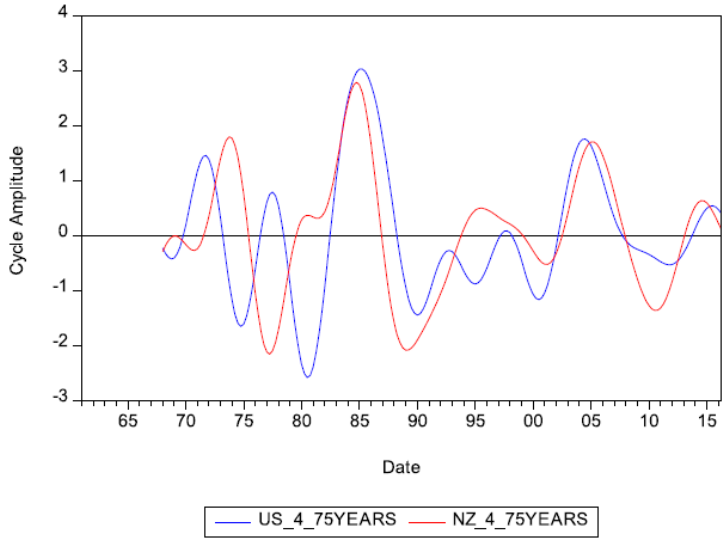

Figure 2.9: New Zealand and US Financial Cycles

much smaller slope than its New Zealand counterpart. This may reflect the effects of quantitative easing and the use of broad money (M2) in the US during this time. While the US financial cycle has a slightly shorter duration overall than the New Zealand cycle, it is more stable over time (the New Zealand cycle becomes longer post-1986). On average, however, the two cycles appear broadly similar. Concordance analysis between the New Zealand and US financial cycles, which measures the percentage of quarters during which the cycles are in the same phase, reveals that the New Zealand financial cycle has become more synchronised with the US financial cycle after 1986, as can be seen in Table 2.10. Concordance analysis on the short-term financial conditions index (as opposed to the medium-term financial cycle) reveals a similar trend.

	Total (%)	Pre-1986 (%)	Post-1986 (%)
NZ and US Financial Cycles	68.04	52.7	77.3
NZ and US Financial Conditions Indices	52.06	38.89	59.83

Table 2.9: Concordance analysis of New Zealand and US Financial cycles.

Table 2.10 compares the lead-lag of the US financial cycle to the New Zealand cycle. A peak and subsequent contraction of the US cycle is followed by a peak and contraction in the New Zealand cycle 75% of the time, within a median of 2.4 years. There are two exceptions among the observed peaks: the NZ contractions dated 1985:1–1989:1, and the current contraction which began in 2014. These results hint at the possibility of important spillover channels from US financial activity onto New Zealand financial activity as highlighted by Rey (2016) and others.

NZ Contraction	Lag from US Contraction Start
1968 Q2 — 1970 Q4	> 5
1974 Q1 — 1977 Q2	8
1980 Q4 — 1981 Q3	12
1985 Q1 — 1989 Q1	-
1995 Q4 — 2000 Q1	11
2005 Q3 — 2010 Q3	3
2014 Q4 —	—
Median Lag	9.5 Quarters

Table 2.10: Lead-lag analysis of US and NZ financial cycles.

2.5 Discussion

This measure of the New Zealand financial cycle appears to be broadly consistent with the main economic developments during the period. The financial cycle picks up the wool bust of 1967–69 and exhibits a deep trough in the mid-1970s, coinciding with the aftermath of the first oil price shock. Reddell and Sleeman (2008) describe the quantitative restrictions on credit during the late 1960s and the sharp squeeze in credit following the oil price shock. Real house prices fell every quarter from 1975 for the next 5.5 years.

The financial cycle turns again in late-1984 and exhibits another deep trough in the late 1980s. The turning point is consistent with events — namely a 20%

devaluation of the currency in July 1984 and a subsequent downgrading of New Zealand's AAA credit rating in October 1984. Bollard and Buckle (1987) document how all controls on prices, wages, credit, and dividends were lifted in 1984 and 1985. The banking sector was also opened up to competition and banks were freed from quantitative limits on their lending growth and foreign ownership. Trustee banks within New Zealand merged under a new corporate identity, marking a change in the nature and composition of many domestic financial institutions. The floating of the New Zealand exchange rate in 1985 and the passing of the Reserve Bank of New Zealand Amendment Act 1986 also mark a change in the nature of financial activity within New Zealand (RBNZ, 2018). These reforms are reflected in formal econometric tests, which suggest a structural break in the financial conditions index in 1986.

The deeper integration of New Zealand into global capital markets from the late 1980s appears to have resulted in a less volatile financial cycle. The peaks and troughs are noticeably smaller, perhaps reflecting greater international risk-sharing opportunities. The recovery of the financial cycle in the early 1990s is consistent with the housing boom of the time, with the easy access to credit reflected in an annual credit growth rate of 15% at end of 1995 (Reddell and Sleeman, 2008). The subsequent deterioration in financial conditions coincides with the Asian-LTCM crises of 1997–98, which accentuated global risk aversion and impaired the functioning of capital markets for a time.

Craigie and Munro (2010) and Chetwin and Reddell (2012) document the most recent credit boom in New Zealand during the years 2003–7. This was a period of rapidly rising house prices, strong credit growth and substantial private sector dissaving, fuelled by aggressive and risky lending by financial intermediaries. The global financial crisis of 2007–8 and finance company failures from 2006 would seem to account for the final downswing in this measure of the New Zealand financial cycle.

As other researchers have noted (e.g. Aikman et al., 2015; Strohsal et al., 2017), the New Zealand financial cycle is longer than the New Zealand business cycle. My results also suggest that the New Zealand financial and business cycles are less synchronised in the medium-term, but are more synchronised in short-term fluctuations. The relationship between financial and business cycles is particularly relevant since the financial cycle can have an amplifying effect on economic downturns, if financial activity is decreasing simultaneously. Similar to Drehmann et al. (2012), my findings highlight the importance of jointly considering financial conditions and the impact on real economic activity, including how these impacts might change across time, when designing macroeconomic policies.

Following the economic reforms of the mid-eighties, the financial cycle in New Zealand appears to have become much more synchronised with a US (or global) financial cycle. My results thus lend some support to the thesis of Rey (2016), who argues that US monetary policy and financial conditions spill over to other countries, including to countries with floating exchange rates such as New Zealand. Rey finds that when global financial institutions hold US dollar-denominated assets on their balance sheet, there is an indirect transmission of US financial activity and monetary conditions. Macro-prudential policies or capital controls may therefore play an important role, in concert with floating exchange rates, in helping insulate small open economies from global financial shocks. But greater financial integration may also be beneficial by facilitating better risk sharing opportunities; greater capital market integration may serve to safeguard the economy from the ebb and flow of shifting global risk appetite.

2.6 Conclusion

A financial cycle can be regarded as the cyclical fluctuation of financial activity, notably in credit, asset, and money markets. Recent work attempting to measure such cycles internationally suggests that booms and busts in financial cycles have a much lower frequency and larger amplitude than business cycles.

In this chapter, I have estimated a financial cycle for New Zealand over the 50-year period 1968–2017. I report on its main characteristics and the extent to which it is synchronised with the business cycle in New Zealand, and the financial cycle in the United States. My results suggest that the median length of the financial cycle in New Zealand is 8 years, and that its duration increased substantially (from 4.75 to 9.75 years) following the economic reforms of the mid-1980s. The New Zealand business cycle has a much shorter average length (5.9 years) and its volatility has also declined since the mid-eighties. There is a strong degree of synchronicity between the New Zealand financial cycle and the US financial cycle, suggesting international spillovers.

This analysis should be regarded as a tentative first step in constructing a set of stylised facts on the financial cycle in New Zealand. Given the importance of financial stability policies such as macro-prudential policies in the arsenal of modern central banks, a better understanding of financial activity, and its interplay with real variables and global financial conditions, is an important area for future research.

Chapter 3

Revisiting the Origins of New Zealand's 1984 Currency Crisis

3.1 Introduction

The currency crisis of 1984 was a defining moment in New Zealand's economic history, and marked the beginning of New Zealand's transition to becoming one of the most open economies in the world.[1] During the crisis, NZD$1.4 billion dollars was sold by speculators over the course of the attack against New Zealand's fixed exchange rate regime, amounting to 4% of New Zealand's GDP. The crisis was only resolved with a 20% devaluation of the New Zealand dollar on 18$^{\text{th}}$ July 1984, immediately following the election of the Fourth Labour Government. The crisis cost the incoming government $2.47 billion through the increased relative value of official liabilities alone, and was the last in a long line of speculative attacks against the New Zealand dollar before New Zealand adopted a flexible exchange rate regime from 4$^{\text{th}}$ March 1985.

[1] I thank Anthony Endres for his valuable insights and comments on a draft version of this chapter.

Many academics in New Zealand have reflected on the 1984 currency crisis, although none to date have considered the origins of the crisis in the context of the theoretical currency crisis literature. Buckle's (1987) analysis is one of the more comprehensive summaries of New Zealand's economic imbalances at the time of the 1984 exchange crisis, while Easton (1989) and Singleton (2006) explore the events and economic consequences of the crisis more generally.[2] Bordo et al. (2011) consider the history of New Zealand's financial crises from 1890, but limit their scope to identifying the timing and category of financial crises, rather than exploring the theoretical roots of each specific incident.

The development of the currency crisis literature was at an early stage at the time of the 1984 crisis, which limited the insights and applications for New Zealand's policymakers, as well as the insights of commentators on the experience in subsequent years. During the 1980s, the theoretical literature on currency crises only encompassed the "first-generation" pioneered by Krugman (1979), with Flood and Garber's (1984) valuable clarification. The "golden era" of theoretical work on currency crises emerged later, during the 1990s, as extensions to Krugman's insights were pursued in the wake of the European exchange crisis of 1992-93, the Mexican *peso* crisis of 1994, and the East Asian currency crises of the late 1990s.

In this chapter, I revisit the origins of New Zealand's 1984 currency crisis through the lens of the relevant theoretical literature, most of which post-dated the 1980s, and in doing so seek to fill the gap left by early, anecdotal, or generalised inquiries. I compare monthly and weekly data (Appendix D) that has been hand-collected from the 1954-85 Reserve Bank of New Zealand (RBNZ) bulletins against a selection of key theoretical models to shed some light on how, when, and why the New Zealand currency crisis occurred as it did in June and July 1984.

[2]Other key authors in this area include Evans et al. (1995), Kelsey (1997), and Dalziel (2002), who consider the broader set of reforms introduced by the incoming government alongside the liberalisation of New Zealand's exchange rate.

The theoretical models that I consider include first-generation crises, which emerge as a result of steadily declining fundamentals; second-generation crises, which emerge as a result of self-fulfilling market expectations; and a range of extensions to second-generation models, such as third-generation "sudden stops", the impact of contagion in currency crises, and the role of political economy factors in the development of crisis expectations.

The events and indicators surrounding New Zealand's 1984 currency crisis most closely resemble Obstfeld's (1994) second-generation model of self-fulfilling expectations, with elements of Rother's (2009) political economy extension to illustrate how these expectations can form in close proximity to an election. The 1984 crisis also has some similarities with Caplin and Leahy's (1994) "contagion" of information between countries. The New Zealand experience closely mirrors the Australian currency crisis that occurred in March 1983, suggesting that the self-fulfilling expectations of Obstfeld (1994) and Rother (2009) may have been amplified by observations on foreign currency crisis responses.

Models of theoretical currency crises that depend on declining fundamentals, such as Krugman (1979), Flood and Garber (1984), and Morris and Shin (1994), are not necessarily a good fit for the New Zealand case. New Zealand's currency crisis occurred at a time when the "fundamentals" of New Zealand's economy — such as the balance of payments and the level of unemployment — were beginning to improve after a decline in prior years, indicating that the timing of the crisis was determined by a sudden change in market sentiments rather than a change in the fundamental nature of New Zealand's economic outcomes. There is little evidence to suggest that New Zealand experienced a third-generation "sudden stop" crisis, as in Calvo (1998) and Krugman's (1999) analyses on the role of international capital flows.

The chapter is structured as follows. First, I consider key events in New Zealand's economic development that led to the 1984 currency crisis, including the events of the 1984 crisis itself. I then consider the 1984 currency crisis through the lens of key theoretical models in order to determine which model best approximates the New Zealand case, before exploring some relevant insights and lessons.

3.2 The New Zealand Experience

The New Zealand dollar (NZD) was devalued by 20% on 18$^{\text{th}}$ July 1984 following an aggressive speculative attack over the preceding month, with signs that some speculators were beginning to withdraw their domestic assets as early as August 1983. The attack and subsequent devaluation was New Zealand's final currency crisis under its' fixed exchange rate regime before the NZD was officially floated on 4$^{\text{th}}$ March 1985.

3.2.1 Pre-crisis origins

The 1984 currency crisis was the culmination of external imbalances and domestic policy decisions that led to unaddressed pressures for the devaluation of the NZD. Therefore, to best consider the 1984 currency crisis, it is useful to first consider how the history of New Zealand's exchange rate regime led to the economic climate faced by New Zealand policymakers in 1984.

3.2.1.1 A brief history of the New Zealand exchange rate

New Zealand's fixed exchange rate regime began in the Gold Standard era, where the New Zealand pound was maintained at parity with the pound Sterling (GBP) until the abandonment of the Gold Standard in 1914. Quotes for the New Zealand pound during the 1930s reveal a depreciation in 1931 and again in 1933 in the midst of the Great Depression for a total depreciation of 25%. The RBNZ subsequently returned the New Zealand pound to parity with the GBP in 1948 by revaluing the New Zealand pound 25%.[3] New Zealand maintained this parity with the GBP until IMF membership in 1961 required that the New Zealand exchange rate be quoted against the US dollar (USD).

The New Zealand pound was replaced by the NZD in July 1967, and the NZD was subsequently devalued 19.25% against the USD in December 1967 to maintain parity with a devalued Australian dollar (AUD). New Zealand's exchange rate was then fixed against a basket of key trading partners' currencies from July 1973, following the dissolution of the Bretton Woods system and the short-lived Smithsonian Agreement. The choice to retain a fixed exchange rate regime was at odds with the majority of other developed countries, that mostly adopted flexible exchange rates from June 1972 (with the notable exception of Australia, that also maintained a fixed exchange rate against a basket of currencies from 1974).

There were several adjustments to the New Zealand exchange rate between 1973 and 1979 in response to various balance of payments crises, the most notable of which resulted in a 15% devaluation in 1975. New Zealand adopted a monthly-adjustable crawling peg between June 1979 and June 1982, with the nominal NZD persistently depreciating over this period. The crawling peg subsequently reverted to a fixed exchange rate regime from June 1982 until the regime was abandoned with the floating of the NZD in March 1985.

3.2.1.2 A summary of New Zealand's foreign exchange crises

New Zealand experienced a number of currency and balance of payments crises during its fixed exchange rate regime, the majority of which were initially caused by negative terms of trade shocks that led to deficits in New Zealand's balance

[3]The justification for returning the New Zealand pound to parity with the GBP was that New Zealand's financial markets were not sufficiently "self contained", as a significant portion of capital was held by trading banks in London at the time (Department of Statistics, 1962). Indeed, in 1948, 9.7% of all trading bank assets were held in London, and 13% of state debt was denominated in GBP (Department of Statistics, 1948).

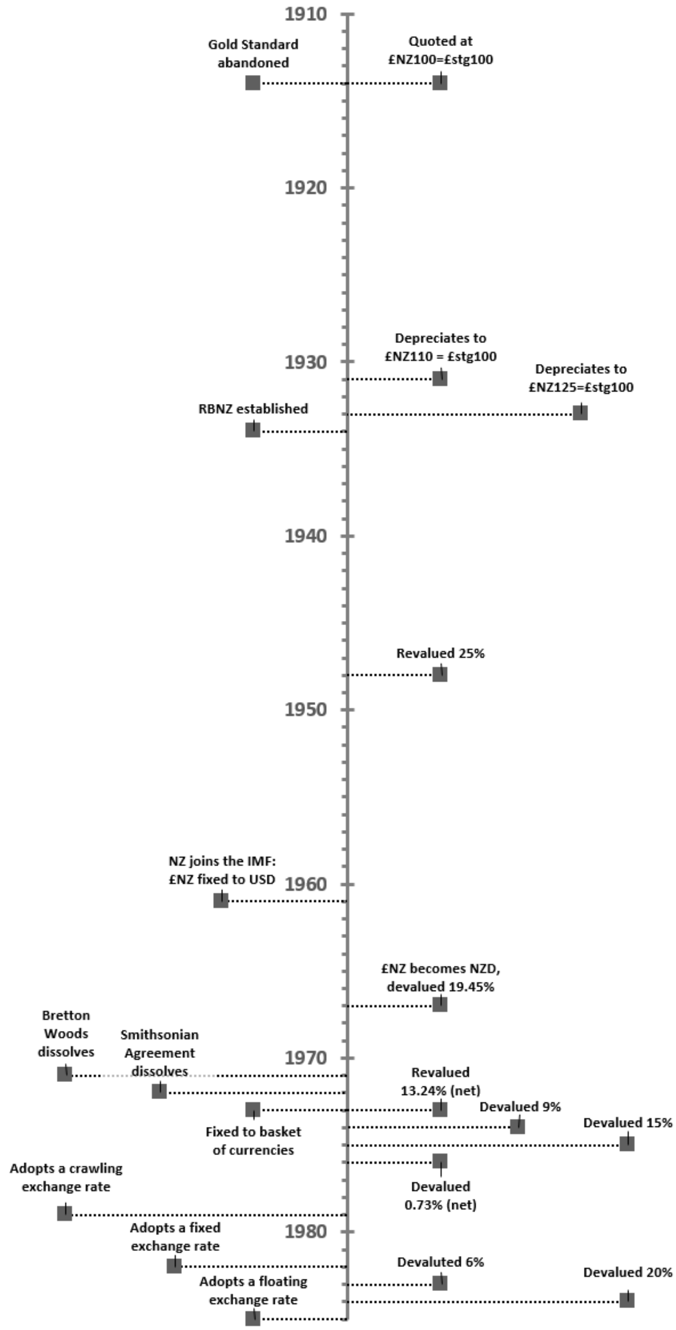

Figure 3.1: Timeline of the New Zealand exchange rate, 1910-1985. (Source: RBNZ website)

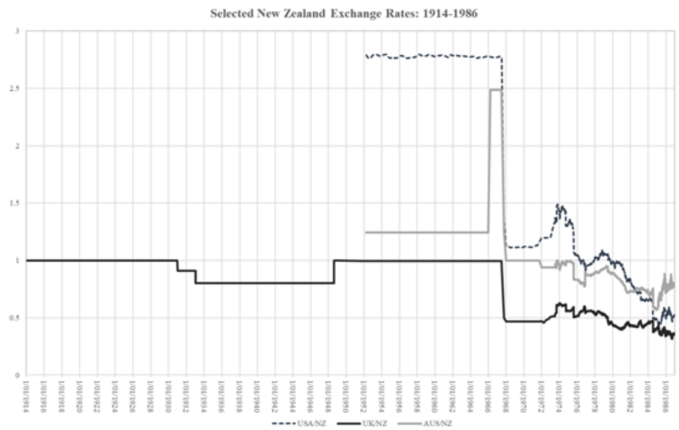

Figure 3.2: Selected New Zealand exchange rates, 1914-1986. (Source: RBNZ website and RBNZ Bulletins)

of payments. Bordo et al. (2011) empirically identify three currency crises in the 1930s, along with crises in 1967, 1974-75, 1979-80, and 1984. Hawke (1985) and Quigley (1992) anecdotally identify three additional balance of payments crises beginning in 1951, 1957, and 1961, although these crises did not see a devaluation of New Zealand's currency in response to the run on official foreign reserves.[4]

Following the end of the Second World War, New Zealand's 1951-52 balance of payments crisis was caused by the collapse of the 1950-51 wool and commodity price boom (Easton, 1997). The subsequent 1957-58 balance of payments crisis was also sparked by a collapse in New Zealand's butter export prices to the UK, and led to a steady decline in the balance of official foreign reserves (Hall, 2017). This crisis led to the reinstatement of import and exchange controls that had been heavily relaxed over the preceding decade, and New Zealand had extremely reduced access to international capital markets during this time, leading to historically high interest terms from London and New York to replenish government reserves (Hawke and Wijewardane, 1972).

[4]Bordo et al. (2011) identify New Zealand's currency crises by considering weighted changes in the exchange rate, foreign reserves, and the short-term interest rate, a method that limits the identification of currency crises that were resolved by means other than a devaluation, as in the 1951, 1957, and 1961 crises.

The balance of payments crisis that emerged in 1960-61 nearly exhausted the RBNZ's balance of overseas assets, and was the result of a two-sided decline in New Zealand's terms of trade alongside a complete lack of access to international capital markets (Hawke and Wijewardane, 1972). The crisis led New Zealand to petition for IMF membership in 1961 so as to reopen international lending channels (Hawke, 1985), and also led to the introduction of fiscally expensive export promotion schemes from 1962 as policymakers accepted that import licenses alone were "not sufficient" as a "balance of payments instrument" (Wooding, 1987). Inflation began to increase in New Zealand following this crisis, which partially reflects fiscally expensive export promotion policies, and partially reflects the inflationary impact of the import licenses that remained a staple of New Zealand's exchange policy until 1985.[5]

New Zealand's balance of payments crisis in 1967 was caused by declining export wool prices, and exacerbated by early-1967 anti-inflationary measures that negatively impacted domestic credit growth (IMF, 1967). New Zealand's policy response included a high degree of borrowing from the IMF in response to shrinking official foreign reserves. The crisis was subsequently associated with the most significant increase in unemployment in New Zealand's history, and led to the intensification of export subsidy schemes to promote domestic growth and ensure a healthy trading balance going forward (Johnson, 1987).

The global oil crisis in 1974-75 led to New Zealand's next balance of payments crisis as import payments rose, and the change in these relative prices was exacerbated by New Zealand choosing to maintain its fixed exchange rate regime against the depreciating US dollar until 1973. The crisis led to significant lending from

[5]Aizenman (1981) relevantly notes that importers might not choose to reduce the volume of imported goods as expected during a nominal depreciation, if import licenses are sufficiently restrictive. Furthermore, one could see an *increase* in import volumes as import restrictions are eased even if import prices are rising, as was the case for New Zealand during the gradual liberalisation of its international accounts between 1961 and 1985, which can further contribute to domestic inflationary concerns.

the IMF as private sources of international borrowing became "difficult" and also required the temporary imposition of price, wage, and interest rate controls to curb domestic inflation (IMF, 1974)[6].

The penultimate 1979-80 balance of payments crisis was caused by a decline in New Zealand's export prices, and occurred during a time of high government debt and high domestic inflation. The crisis resulted in two small devaluations, as well as New Zealand's final instance of IMF borrowing in order to preserve the balance of official foreign reserves. New Zealand subsequently adopted an adjustable crawling exchange rate from June 1979 to "maintain exporters' incomes" (Deane, 1981), which resulted in the consistent depreciation the NZD by an average of 0.5% per month until 1982.

3.2.2 When did a currency crisis become possible for New Zealand?

There are three economic conditions that are necessary for a currency crisis to occur: the nominal exchange rate must be overvalued, there must be some limitation on the government's capacity to convincingly expand its official foreign reserves, and there must be a violation of the classic Mundell-Flemming trilemma of international finance (which makes the observation that policymakers can only maintain two of three desirable economic policies: a fixed exchange rate regime, independent monetary policy, and the free flow of capital).

3.2.2.1 When did the nominal exchange rate become overvalued?

A currency crisis can only occur if a country has a nominal fixed exchange rate that is overvalued relative to the "real" exchange rate that would prevail upon reversion to a flexible exchange rate regime. This is because a devaluation of the domestic

[6] New Zealand would draw a peak of 192% of its special drawing rights from the IMF in 1977.

currency is necessary to induce speculators to sell local currency assets and receive a "windfall" through the increased relative value of internationally denominated assets (Krugman, 1979; Flood and Garber, 1984). An overvaluation "gap" between the real and nominal exchange rates is therefore likely to emerge in a currency that is experiencing a depreciation in its real exchange rate (as driven by high domestic inflation), but is resisting a nominal devaluation. This may be the case for a country with a high level of foreign-denominated debt (Obstfeld, 1994), or a country with powerful lobby groups that have a vested interest in an overvalued currency (Rother, 2009).

The simplest measure of a real exchange rate will see the depreciation of the domestic currency when the foreign rate of inflation is higher than the domestic rate of inflation.[7] Although New Zealand does not yet have a comprehensive real effective exchange rate index that predates 1964, we can infer that the New Zealand dollar became significantly overvalued relative to trading partners' currencies before 1964, as the sharp devaluations of 19.45% in 1967 and 15% in 1975, as well as the cumulative devaluation of 22.6% between 1979 and 1982, were not sufficient to resolve New Zealand's overvaluation pressures by the time of the 1984 currency crisis.

The source of New Zealand's "original" overvaluation is not entirely clear, although it very likely emerged during the pre- and post-war adjustments of the 1930s and late 1940s. The New Zealand pound was devalued twice during the 1930s to appropriately reflect disparities between the rate of inflation in New Zealand and weaker rate of inflation in the UK. As Figure 3.3 shows, the rate of inflation in New Zealand over the following decade was persistently and considerably lower than the rate of inflation in both the UK and the US, which supports the 1948 decision to revalue the New Zealand pound relative to the GBP.

[7] Other approximations of the real exchange rate include an index of the relative prices of non-traded and traded goods, as in Easton (1997), and trade-weighted changes in relative price indices, as in BIS (2006).

Figure 3.3: NZ, UK, and US quarterly inflation, 1914-1985. (Source: RBNZ, BOE, BIS)

Figure 3.4: Monthly effective nominal and real NZD exchange rate indices, 1965-2000. (Source: BIS; three-year narrow trade weights, 2010=100)

However, Easton's (1997) comparison of non-traded and traded price indices suggests that one measure of New Zealand's real exchange rate depreciated by 55.7% between 1931 and 1949.[8] By this reckoning, the cumulative nominal depreciation

[8]Bordo et al. (2011) also provide an estimate of New Zealand's real exchange rate between

of 25% by 1933 would have been insufficient to address the full extent of New Zealand's real depreciation to begin with, and the subsequent revaluation of 25% in 1948 means that the depreciation of New Zealand's real exchange rate was unaccounted for in New Zealand's nominal exchange rate by the end of these two decades. The New Zealand exchange rate was then left unchanged until the 19.45% devaluation in 1967. This series of events could justify the gross extent of the overvaluation present at the beginning of the BIS' estimate of New Zealand's real effective exchange rate, which only dates from 1964 (Figure 3.4).

Importantly, the degree of overvaluation in the New Zealand nominal exchange rate began to decline after the 1967, 1974, and 1975 devaluations, as well as during during the adjustable-crawling exchange rate regime that was in place between 1979 and 1982. However, by the time the fixed exchange rate regime was reinstated in June 1982, officials at the RBNZ were of the opinion that the NZD needed to be devalued by a further 12 - 24% to resolve any residual overvaluation and eliminate the risk of another currency attack (Singleton, 2006).

3.2.2.2 When did New Zealand have a limited capacity to expand official foreign reserves?

A healthy balance of foreign reserves is necessary to maintain a fixed exchange rate regime, which means that a government with a limited ability to expand its balance of official foreign reserves (for example, a government that is unable to raise new borrowing overseas) is more likely to be faced with a currency crisis (Krugman, 1979; Buiter, 1986). This also suggests that access to international borrowing, or the use of forward contracts over the nominal exchange rate, will prolong the existence of a fixed exchange rate regime.

1880 and 2008 using the relative price indices of New Zealand and the UK, although this is a bilateral index that only considers one of New Zealand's trading partners, becomes less relevant as New Zealand trade shifts away from the UK after the 1950s. Bordo et al. observe a deterioration in the real exchange rate between New Zealand and the UK between 1880 and 1930, which was unresolved by depreciation during the 1930s.

The ability of New Zealand policymakers to expand foreign reserves has historically depended on New Zealand's relationship with the IMF, the extent of foreign-denominated public debt, and on the RBNZ's access to forward exchange markets so as to influence the nominal exchange market.[9]

New Zealand suffered from an inability to expand official reserves during the 1960-61 balance of payments crisis, as international markets closed to New Zealand on account of not being an IMF member. Membership with the IMF from 1961 subsequently acted as a signal of New Zealand's economic priorities to international lenders, and re-opened international capital markets while also providing New Zealand with access to cheap lending from the IMF and the World Bank directly. However, New Zealand's access to IMF drawings declined after 1979 as the IMF began to limit the extent of their lending to developed countries (Boughton, 2001).[10] This meant that after 1980 New Zealand could only borrow from private international sources, which would increase the cost of borrowing and limit New Zealand's capacity to fund the expansion of official foreign reserves in response to a speculative attack.

The increasing amount of government debt issued by the New Zealand government at the beginning of the 1980s, of which a significant portion was denominated in foreign currencies (see Figure 3.5), also made many international lenders wary of extending additional lending, as noted in New Zealand's Article IV consultation with the IMF in 1983. Although some portion of New Zealand's public debt had always been denominated in foreign currencies, the portion of public debt that was foreign-denominated increased significantly in the decade preceding 1984. Overall, New Zealand's foreign debt increased from $465.2 million as of 31 March

[9]The ability of the RBNZ to expand its balance sheets has depended on international capital markets more generally due to the historically thin and underdeveloped local capital market, which limited the extent to which the RBNZ could raise capital in the local market.

[10]IMF priorities shifted after the significant draw on IMF resources by developed members during the 1970s oil price shocks. At the time, executives within the IMF noted that the Fund could not act as a "lender of last resort" on this scale, and the IMF subsequently shifted its focus towards developing and emerging economies that were facing severe economic distress.

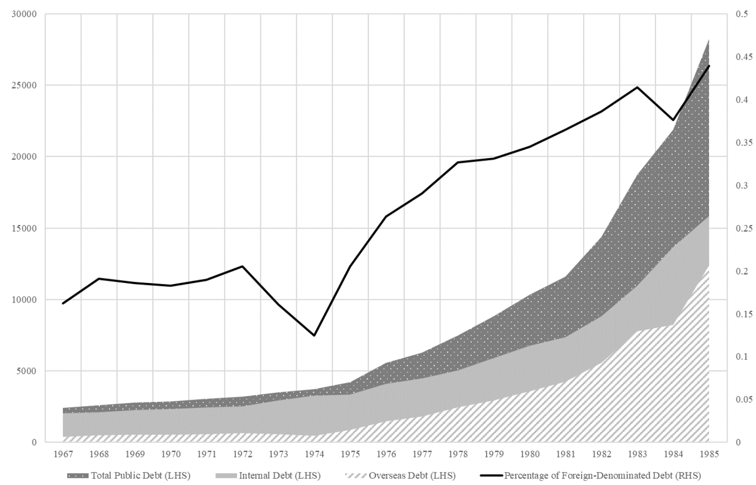

Figure 3.5: Annual New Zealand public debt denomination (NZ$000s) and percentage of total debt denominated in foreign currencies, 1967-1985. (Source: Statistics NZ Yearbooks)

1974 (which amounted to 12.5% of total official debt) to $7,764.7 million as of 31 March 1983 (which amounted to New Zealand's highest ratio of official debt to be denominated in foreign currencies since World War II, at 41.4%). The ratings agency Standard and Poors downgraded New Zealand's credit rating from AAA to AA+ in April 1983 in keeping with changing international appetite for New Zealand borrowing.

Finally, the RBNZ indicated in an announcement on 5$^{\text{th}}$ August 1983 that it would no longer participate in the forward exchange market for the New Zealand dollar (Singleton, 2006).[11] Engagements with the forward market had cost the RBNZ $440 million over the 1982-83 and 1983-84 financial years, and was no longer sustainable (RBNZ, 1984). This withdrawal by the RBNZ signalled to market participants that officials had a reduced "pool of reserves" to draw from in the event of a future speculative attack, thus limiting the perceived ability of the government to defend the currency (as in Obstfeld, 1979).

[11] Easton (1989) notes that the RBNZ had "informally" withdrawn from the forward exchange market as early as March 1983.

In light of these considerations, it could be said that New Zealand's ability to expand its reserves and defend against a currency attack declined after 1980, and declined further in August 1983, making a speculative attack more likely to succeed from this month onward.

3.2.2.3 When was the international trilemma violated?

The classic Mundell-Flemming "trilemma" of international finance suggests that a policymaker can only choose to maintain two of three desirable economic policies, which are a fixed exchange rate, independent monetary policy, and the free flow of capital. A violation of this trilemma, in the event that New Zealand had a fixed exchange rate regime, would occur if New Zealand policymakers also permitted the free movement of international capital while maintaining independent monetary policy; in this case, the fixed exchange rate regime would inevitably come under attack as speculators used the open capital account to take advantage of interest rate disparities between independent domestic monetary policy and global interest rates. Importantly, the free movement of international capital could refer to the flow of financial assets, or to the flow of exchange to settle trade balances, and a speculative attack generally becomes more likely as either of these flows become more liberated (Shatz and Tarr, 2000).[12]

In considering the point at which the New Zealand economy became susceptible to the 1984 currency crisis, it is useful to establish that New Zealand has operated internationally independent monetary policy, before identifying when New Zealand had a sufficiently free flow of international capital as to facilitate a speculative attack.

Graham and Smith (2012) demonstrate that New Zealand operated internationally independent monetary policy throughout the history of the RBNZ, which was

[12]Relevantly, a key critique of the international Bretton Woods system, which maintained fixed exchange rates between the majority of global economies, is the inherent conflict between fixed exchange rates and a liberalised trade account (Endres and Rogers, 2014).

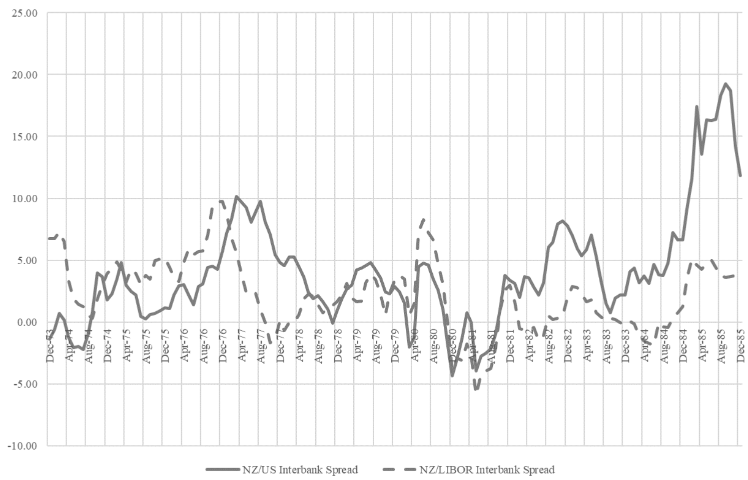

Figure 3.6: Monthly spread between rates on 3-month New Zealand and UK bills, and New Zealand and US bills, 1973-1985. (Source: RBNZ Bulletins, St. Louis Fed)

explicitly established in 1934 to improve "diversification" between New Zealand, Australian, and the UK monetary systems. Figure 3.6 highlights differences between the rates for short-term bills in New Zealand, the UK and the US. In particular, it shows that New Zealand short-term rates were significantly higher than in the US after December 1981, suggesting that this aspect of the violation of the trilemma became more pronounced from 1982.

Historically, the flow of funds into and out of New Zealand closely matched the extent of import and other trade controls, which the New Zealand government tightened significantly in 1957 and gradually loosened thereafter. Although some aspects of these trade and exchange controls had been relaxed following IMF membership in 1961, these controls were eased more rapidly after New Zealand's membership with the OECD from 1973, and particularly after the "liberalisation" budget of 1979 (RBNZ, 1985; Wooding, 1987). In addition, the New Zealand government invited applications for new foreign exchange dealership licenses in early 1983, intending to increase the competitiveness of New Zealand's foreign exchange market. This resulted in the issue of nine new foreign exchange licenses in August 1983, and effectively increased the development and sophistication of New Zealand's capital markets. This easing of controls on international capital flows in the presence of independent monetary policy and a fixed exchange rate regime again suggests that the possibility of a currency crisis occurring became more pronounced as the 1980s progressed.

3.2.3 The 1984 currency crisis

The two years preceding the 1984 currency crisis were defined by an infamous price, wage, and rent freeze, increasing liberalisation in the exchange account, and conflicting restrictions on New Zealand's trading account, which led to skepticism over the longevity of New Zealand's return to a fixed exchange rate regime. The events here, unless otherwise specified, are drawn from the economic chronology and official statistics of RBNZ bulletins between 1982-85.

3.2.3.1 New Zealand re-establishes a fixed exchange rate regime

New Zealand began 1982 with a persistently negative trade balance and invisibles balance (the latter of which captures the international balance of investment or debt servicing flows) while export prices declined marginally, and import volumes increased sharply. The burden of government debt repayments rose to 6.2% of exports for the year ended March 1982. Inflation climbed to 16.9% by June 1982, and Prime Minister Muldoon subsequently introduced a comprehensive 12-month price, wage, and rent freeze on 22nd June 1982, followed by the re-introduction of a fixed exchange rate regime from the 23rd June. The freeze on prices, wages, and rents was expected to expire in June 1983, although there was no indication for an expiration on New Zealand's fixed exchange rate.

3.2.3.2 Devaluation and trade policy following the 1983 Australian election

On 5th March 1983, a snap election in Australia led to a change in government seven months ahead of the scheduled October election, and the incoming Australian Labour government immediately devalued the AUD by 10% after assuming office. The governing New Zealand National party accordingly devalued the NZD by 6% to maintain competitiveness, and later passed the final reading of the Closer Economic Relations (CER) trading agreement between Australia and New Zealand on 28th March, which would gradually eliminate all exchange and trade controls between the two countries. In contrast to the CER commitment to eliminate trade and financial barriers by 1995, however, the New Zealand government imposed tighter restrictions on import licenses from 30th March 1983 in an attempt to improve New Zealand's worsening trade balance with the rest of the world, and prevent further capital outflows.

3.2.3.3 Failed speculative attack

Figure 3.7: Weekly short-term overseas assets of the RBNZ (NZ$000's), March 1983 to August 1983. (Source: RBNZ Bulletins)

The twelve-month freeze on prices, wages, and rents was expected to expire in June 1983, and markets may have assumed that the same expiration date would apply to the fixed exchange rate regime, given that there had been no announcement on this matter. A small run on New Zealand official foreign reserves occurred in May 1983 immediately before this anticipated “expiration”. As shown on Figure 3.7, the RBNZ saw a run on its short-term overseas assets from a peak of $808.2 million on 27th April to $442.2 million by 28th May, which corresponded with a marginally small weakening of the nominal New Zealand exchange rate. The run slowed after Prime Minister Muldoon’s 23rd May announcement that the price, wage, and rent freeze would be extended further to February 1984. The RBNZ’s short-term overseas assets remained at a relatively low level over 1983 and the first quarter of 1984, falling to a low of $38.1 million on 14th September 1983.

3.2.3.4 Interest rates begin to increase

The interest rates offered to the New Zealand government during ordinary stock tenders began to increase from March 1983, after Prime Minister Muldoon’s announcement of a new stock offering that bore a higher yield than any other government stock on offer. The new “Kiwi Savings Stock” was later pulled from the market in June 1983, when Prime Minister Muldoon also indicated a significant reduction in the interest yields that would be accepted on government securities. Despite this, the average yields on government stock increased sharply from October 1983, and the New Zealand government rejected 68.8% of total offerings in the November 1983 stock offering, suggesting that the proposed yields were higher than the yields the government was willing to accept.

The interest yields offered by the market for New Zealand stock tenders continued to increase beyond what the New Zealand government was willing to accept, despite an announcement by Prime Minister Muldoon on 18th November

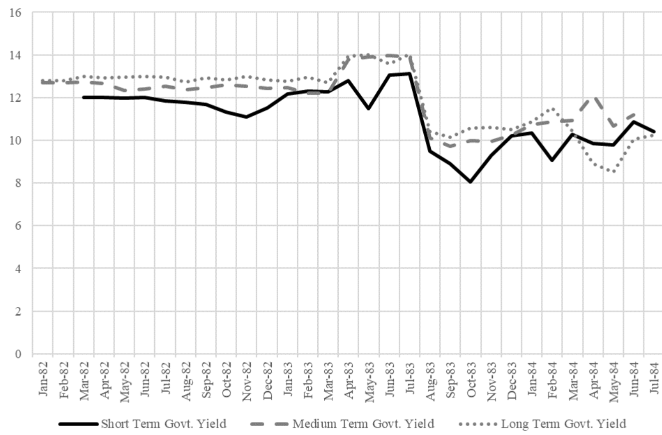

Figure 3.8: Monthly average yields on short-term, medium-term, and long-term New Zealand government bonds, 1982-1984. (Source: RBNZ Bulletins)

1983 that the method of allotment for tenders would change to a uniform yield (all stock would be issued with the highest accepted yield), limiting the possibility for diversity and upward pressure in offerings. In February 1984, the government only accepted 52.3% of bids, and the National government's final stock tender on 7$^{\text{th}}$ June 1984 accepted only 33.4% of market offerings, suggesting that the interest rates offered by market participants had increased significantly beyond the "official" interest rates accepted by the government in Figure 3.8.

The New Zealand government yield curve partially inverted in March 1984 as long-term yields on New Zealand stock fell, and short-term yields continued to increase, which is often interpreted as a signal of financial distress by capital markets.

3.2.3.5 Building expectations of exchange rate liberalisation

Following Prime Minister Muldoon's May 1983 announcement, the freeze on prices, wages, and rents was expected to end on 29$^{\text{th}}$ February 1984. In anticipation of this, New Zealand trading banks began to shift their assets outside New Zealand, and there was a sharp decline in net foreign private assets from $285.5 million in

January 1984 to $135.1 million in February. This steep decline was followed by further, smaller declines in net foreign private assets over the following months (Figure 3.9).

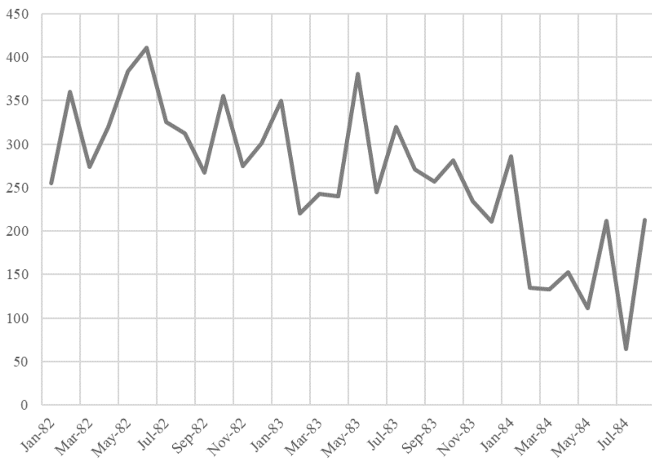

Figure 3.9: Net monthly international assets for New Zealand trading banks (NZ$000's), January 1982 to July 1984. (Source: RBNZ Bulletins)

On 1st February 1984, Prime Minister Muldoon extended the price, wage, and rent freeze indefinitely, until an agreement could be made on long-term wage setting in New Zealand. Prime Minister Muldoon also imposed a ceiling on interest rates from May 1984, with non-mortgage securities limited to no more than 15% for trading banks, savings banks, and building societies, and 17% for finance companies. The "Rent Limitation Regulations" were subsequently introduced from 29th February to allow 3% annual increases in rent, and April 1984 saw an announcement that general wages would be allowed to increase by $8. These policy measures signalled to the market that the remaining freezes on prices, and possibly the exchange rate, could be removed in the near future, which likely drove expectations of an adjustment to New Zealand's fixed exchange rate regime.

3.2.3.6 Trade controls weaken

An announcement on 4th April 1984 revealed the value of imports purchased under license would increase by 5% to reflect rising import costs, slightly easing New Zealand's exchange controls and worsening the trade balance. An announcement was then made on 10th April that New Zealand's system of import licenses would be phased out and replaced by a system of tariffs by 1988, after a long period of consultation between the New Zealand Government and the Manufacturers Federation (Wooding, 1987).

Against this backdrop of upward pressure on interest rates, expectations of a devaluation, the withdrawal of foreign funding, and increased liberalisation in its trade and exchange accounts, New Zealand's nominal exchange rate began to depreciate against the reference basket of trading currencies in April 1984.

3.2.3.7 Speculative attack following election announcement

Prime Minister Muldoon announced on 14th June that there would be a snap election on 14th July, four months ahead of the election that would have been scheduled for November that year. The Leader of the Opposition, David Lange, was assumed to be in favour of devaluation due previous statements made by the Labour party's finance spokesperson, Roger Douglas, even though specific references to devaluation had been removed from Douglas' manifesto by February 1984 (Easton, 1989). Lange was polling ahead of Prime Minister Muldoon at the time when the election announcement was made, and the probability of a re-election for Prime Minister Muldoon was further diminished as several members of the National caucus indicated that they would not support Prime Minister Muldoon in upcoming bills, signalling division within the National party.

On Friday 15th June, following Prime Minister Muldoon's announcement, the markets began a severe run on New Zealand dollar assets, leading the Government to choose between selling foreign exchange reserves or allowing the dollar to depreciate (and ultimately choosing the former). The RBNZ sold US$110 million in the first half hour of trading on Friday 15th, with $256 million in foreign exchange sold over the entire trading day (Easton, 1989).[13] Singleton (2006) notes that New Zealand's balance of official foreign reserves at the close of Friday 15th comprised $330 million in liquid reserves, $842 million in long-term reserves, and $1,124 million in stand-bys.

Market participants became aware of the size of the outflow that occurred on 15th June, and the "low foreign exchange reserves position" within the RBNZ was "well-known to banks and dealers" by the end of the weekend (RBNZ, 1984). The Governor of the RBNZ, Spencer Russell, extended a memo to the Government on 17th June that recommended a devaluation of 15% to satisfy market expectations. The contents of this memo also became "widely known" to markets by the time trading opened on Monday 18th June (Easton, 2009).

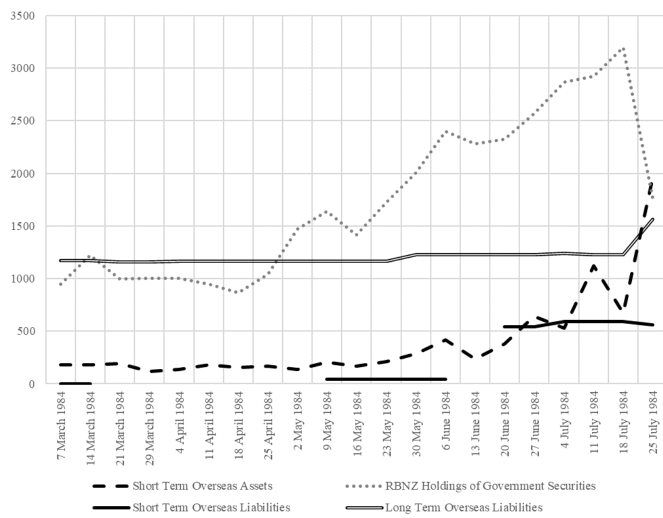

Figure 3.10: Selected weekly assets and liabilities of the RBNZ (NZ$000's), 7 March to 25 July 1984. (Source: RBNZ Bulletins)

[13]To understand the severity of this outflow, RBNZ forecasts anticipated an outflow of $140 million for the entire month of June (RBNZ, 1984).

The RBNZ subsequently re-entered the forward exchange market to fill \$436 million in contracts within the first half-hour of 18th June, in an attempt to stabilise the NZD (Singleton, 2006). The RBNZ entered into a total of \$1.222 billion in forward contracts by 14th July, of which \$1.025 billion fell due before August 1984.[14] The RBNZ also closed the forward market to "non-residents and to government-owned corporations" from 18th June, to prevent speculative activity.[15] Between 13th June and 20th June, the RBNZ raised \$542 million in new short-term overseas liabilities, while only increasing short-term overseas assets by \$140.7 million and government security holdings by \$44.6 million, suggesting a total shortfall of \$356.7 million in RBNZ assets to stabilise the nominal exchange rate over this week.

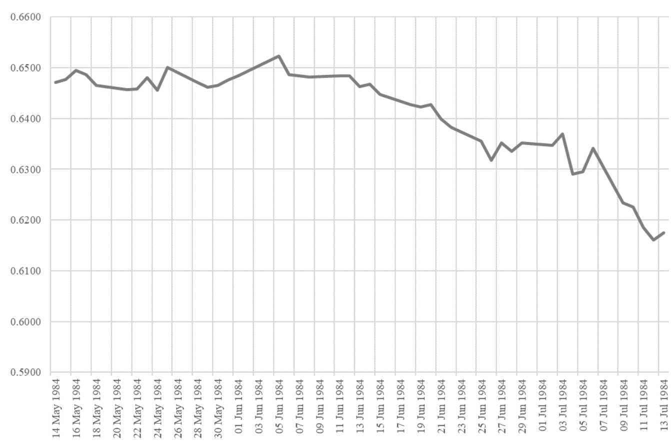

Figure 3.11: Daily nominal USD/NZD exchange rate, 14 May to 13 July 1983. (Source: RBNZ website)

These measures successfully delayed the need for a significant devaluation, but were increasingly unsuccessful in maintaining the marginal value of New Zealand's exchange rate. The NZD depreciated an average of average of -0.22% per trading day against the USD between 18th June and 14th July (Figure 3.11).

[14] The first of these forward contracts was due on 20th July, with a value of \$112 million (RBNZ, 1984).

[15] Import controls were considered by officials, but discarded as implausible due to the "very short-term" nature of the crisis.

3.2.3.8 Speculative attack immediately before election day

The measures imposed by the RBNZ on 18th June successfully "quietened" financial markets, and there was modest selling of the NZD until the trading week immediately preceding the election (Easton, 2009).[16] New Zealand's nominal exchange rate experienced its largest daily depreciation of -1.69% on Monday 9th July, the first day of the final trading week before the election, while Friday 13th July saw a run of $178 million New Zealand dollars (Singleton, 2006). Daily sales of New Zealand assets averaged $100 million per day over the week Monday 9th to Friday 13th July.

By the day of the election, the RBNZ had drawn down $1.713 billion in stand-bys and international loans over the preceding month, and had a remaining balance of $904 million in liquid overseas assets, and $562 million in long-term overseas assets, with only $537 million remaining in stand-bys.

3.2.3.9 Election day and the devaluation of the NZD

The Labour Party, led by David Lange, was elected in theSaturday 14th July election. In a meeting on Sunday 15th July, RBNZ Governor Spencer Russell agreed with other senior officials that the New Zealand exchange markets could not open without a devaluation.

New Zealand then faced a small constitutional crisis as the outgoing Prime Minister Muldoon did not agree with the incoming Prime Minister's advice to allow a devaluation, and refused to make a joint statement on this matter. New Zealand's foreign exchange markets were closed on Monday 16th and Tuesday 17th to resolve the matter. Markets re-opened on Wednesday 18th July with a 20% nominal devaluation in the New Zealand dollar.

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[16] New Zealand did, however, see a significant decline in its trading balance as importers brought forward payments and exported repatriated receipts in anticipation of a devaluation. New Zealand's trade balance worsened from a $164.1 million in May 1984 to a negative balance of -$106.5 million in June.

3.3 Through the Lens of the Literature

This section describes the various "types" of currency crises so as to consider which model best fits the New Zealand experience. These models are then used to shed light on some lessons and implications for New Zealand's 1984 currency crisis.

3.3.1 How does New Zealand compare to the literature?

3.3.1.1 First-generation currency crises

First-generation currency crisis models, such as Krugman (1979) and Flood and Garber (1984), feature a government that draws from their supply of foreign reserves to offset net outflows of international assets to maintain a fixed exchange rate regime. In the simple model employed, a net outflow of international assets always occurs when the government runs a budget deficit, as it is assumed that this deficit can only be funded by spending foreign reserves directly, or by increasing domestic money balances and providing speculators with sufficient wealth to buy their own foreign assets. Repeated budget deficits inevitably exhaust the government's supply of foreign reserves, and the government is forced to forfeit its fixed exchange rate regime. This is known as the point of "natural collapse", and is generally accompanied by some domestic inflation to the detriment of domestic market participants.

Krugman's influential paper extends Kouri (1976) and Salant and Henderson (1978) to show that a currency crisis will occur when speculators preempt the "natural collapse" and "attack" the fixed currency by converting the full value of their domestic assets into foreign assets.[17] This exhausts the government's balance of official foreign reserves, and forces an early reversion to a flexible exchange rate regime without resulting in costly domestic inflation. Flood and Garber (1984)

[17] It is relevant to note here that the term "speculator" does not necessarily refer to an active participant on the foreign exchange market. The flow of domestic and international can also be affected by deferred export receipts and increased import payments over the trading account.

note that this speculative attack will occur when the economy suffers a negative domestic shock that causes the "fixed" exchange rate to become overvalued relative to the "real" or "shadow" exchange rate that would prevail upon reversion to a flexible exchange rate regime. Beyond this, Krugman informally considers how a government may use international borrowing or forward exchange contracts to temporarily expand its supply of reserves (an extension formalised by Buiter (1986)), revealing that speculators will execute a sequence of attacks to draw on each of these "additional" reserves. The fixed exchange rate regime is eventually abandoned when the government has exhausted all feasible options to defend the currency.

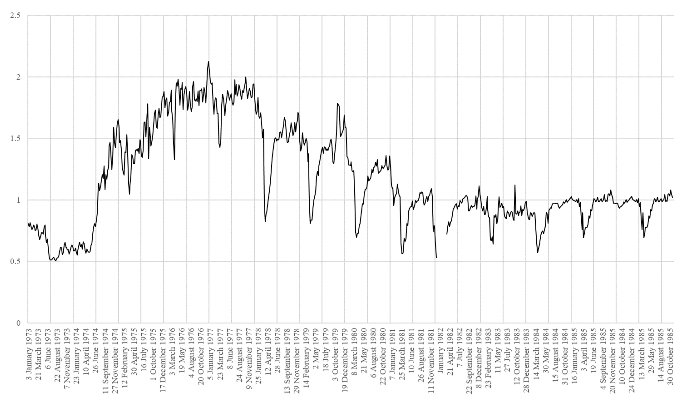


Figure 3.12: Ratio of core RBNZ assets to liabilities, including state assets and state liabilities, 1973-1985. (Source: RBNZ Bulletins)

New Zealand did experience a gradual erosion of official foreign currency reserves from 1976, as reflected in the proxy weekly ratio of assets-to-liabilities of the RBNZ (Figure 3.12), but the decline in official foreign reserves did not reach zero, and New Zealand's balance of payments remained healthy during the months preceding the 1984 speculative attack. This means that speculators were not successful in "forcing" the defending government to exhaust these reserves at the point of devaluation, and the timing of the currency crisis was not determined by a first-generation "fundamental" crisis.

Interestingly, the interruption to the decline in the RBNZ's assets-to-liabilities ratio coincides with the introduction of the wage and price freeze and the return to the fixed exchange rate regime from June 1982. The trajectory of the ratio suggests that if these policies had not been introduced, then New Zealand may have faced a sufficient erosion of official foreign reserves to spark a first-generation currency crisis within three to five years.

3.3.1.2 Second-generation currency crises

One of the key critiques of first-generation models is that they require a currency-defending government to knowingly execute a budget deficit that is contradictory to its intention to maintain a fixed exchange rate regime. Second-generation currency crises models, led by Obstfeld (1994, 1996), resolve this concern by endogenising the government's decision to maintain a fixed exchange rate, which allows speculators to form expectations over future policy decisions.

At the core of Obstfeld's seminal two-period model is a sum of government debt which must be repaid in either the first period (short-term debt) or the second period (long-term debt) subject to some interest rate, i. Repayments on short-term debt can be delayed until the second period (which is equivalent to choosing a first-period government deficit), however this increases the total size of the government's debt due to the compounding effect of interest. The government can repay their second-period debt by raising taxes, increasing the money supply, or increasing the value of their foreign assets by devaluing the domestic currency, and the government will only choose to devalue their currency if they are subject to a sufficiently high interest rate that the cost of raising taxes or increasing the money supply is higher than the cost of a devaluation. This leads to a self-fulfilling crisis where market participants who expect to see a nominal devaluation will demand compensation by offering higher interest rates over government debt, while the act of offering these rates causes a nominal devaluation due to the increase in the size of the government's debt repayments.

The New Zealand experience has many similarities with the insights of second-generation, self-fulfilling currency crisis models with increasing interest rates to herald the crisis, although these models alone are not sufficient to explain the exact timing of the New Zealand 1984 attack.

As outlined in the discussion surrounding Figure 3.8, the implied rate of interest in New Zealand began to increase sharply from October 1983 as yield offerings for government stock increased beyond what the government was willing to accept. This insight, however, suggests that a second-generation currency crisis was possible as early as November 1983, and does little to suggest the timing of the June 1984 speculative attack, when interest rates had been held artificially low by Prime Minister Muldoon's interest rate cap. A "pure" second-generation currency crisis model is insufficient to explain the full scope of New Zealand's currency crisis experience.

One useful extension by Obstfeld shows the impact of foreign borrowing by the government, where foreign-denominated debt reduces the "benefit" of a currency devaluation to the government due to the simultaneous increase in the domestic value of foreign assets *and* foreign liabilities. In this case, the government will still be "forced" to devalue in the event of high interest rates, although the government must now be presented by a higher threshold interest rate to induce this devaluation. The New Zealand government stood to increase the value of their foreign-denominated debt by $2.47 billion under a 20% devaluation, which suggests that, as in Obstfeld's extension, a higher threshold interest rate that would induce the government to accept devaluation as an alternative. It is possible that the New Zealand government simply may not have been presented with a high enough interest rate to induce a "pure" second-generation currency crisis *yet* by June 1984.

3.3.1.3 Third-generation currency crises

Third-generation currency crisis models extend the insights of the second-generation models to consider the role of capital flows and domestic firms' balance sheets in self-fulfilling currency crises. Calvo (1998) is among the first to consider the role of capital flows in this manner in the wake of the 1994 Mexican *peso* crisis, alongside Krugman (1999).

Third-generation currency crisis models introduce domestic entrepreneurs who borrow internationally depending on the value of their domestic wealth (or assets). A "sudden stop" of capital inflows to these entrepreneurs would lead to a decline in the entrepreneurs' wealth, resulting in weaker domestic investment and a depreciation of the real exchange rate. Meanwhile, foreign lenders would choose to enact a "sudden stop" if they believed that a depreciation was imminent, as a depreciation would increase the relative value of the entrepreneurs' international liabilities and therefore weaken the entrepreneurs' ability to borrow in the future. This self-fulfilling aspect of third-generation crises is built around whether or not foreign lenders agree to lend additional capital to domestic borrowers, in contrast to second-generation models, where the self-fulfilling crisis is built around a change in interest rate offerings made on public debt.

There are some extensions to third-generation crises that consider the role of the government's balance sheet in a self-fulfilling currency crisis, such as Cole and Kehoe (2000), who find that currency crises become more probable as the maturity of government debt shortens and the size of the government's debt increases. Bordo, Meissner, and Stuckler (2010) show empirically that an increased ratio of government debt to total debt is associated with an increased incidence of "sudden stops" and associated currency crises.

As in Bordo et al.'s (2011) findings, however, New Zealand did not experience a "sudden stop" during 1984, nor in any of the surrounding years. The nearest

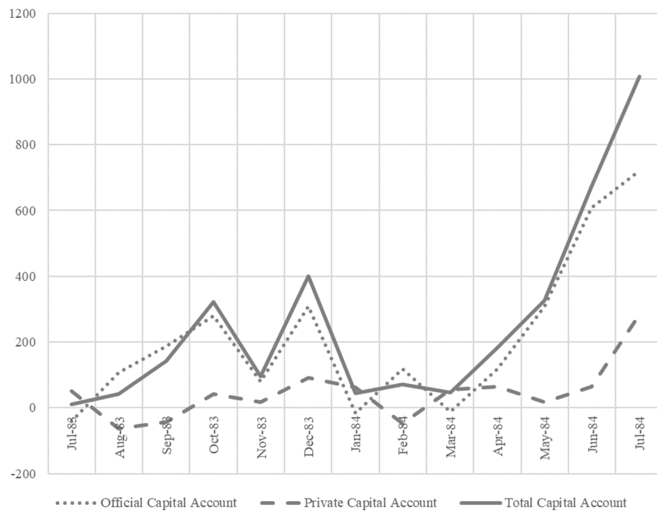


Figure 3.13: Monthly New Zealand capital account balance, 1983-1985. (Source: RBNZ Bulletins)

"sudden stops" on either side of the 1984 crisis occurred in 1976-78 and 1987-88. Figure 3.13 shows that capital inflows to New Zealand were unaffected during the lead-in to the currency crisis in June, which means that a third-generation currency crisis did not occur in New Zealand through lending to private entrepreneurs (as in Calvo (1998) and Krugman (1999)), or to the government (as in Cole and Kehoe (2000)). One could draw some implications from the changing IMF focus in 1979, which effectively acted as an exogenous "sudden stop" of cheap lending for the purpose of balance of payments stabilisation, although this event does not play into the "self-fulfilling" aspect of third-generation crises.

3.3.1.4 Fundamental currency crises

In another extension to second-generation currency crisis models, Morris and Shin (1998) outline a model where self-fulfilling currency crises emerge in response to a unique fundamental quality in the economy, rather than a sudden change in the expectations of market speculators. Morris and Shin transform Obstfeld's model in this manner by introducing imperfect information over the economy, which speculators use to form expectations over the domestic currency.

Morris and Shin begin by defining the fundamental state of an economy, and show that a fixed exchange rate is "sustainable" if fundamentals are strong, "unsustainable" if fundamentals are weak, and "at risk" of a speculative attack if fundamentals are anywhere within a middling range. The latter "range" corresponds to Obstfeld's model, where it is equally possible that the crisis could or could not occur depending on market sentiments. Morris and Shin then introduce imperfect information over the true state of the economy to show that a currency crisis will definitively occur when the economy's fundamentals fall below a unique value, as a sufficient portion of speculators become convinced that a coordinated attack is imminent.

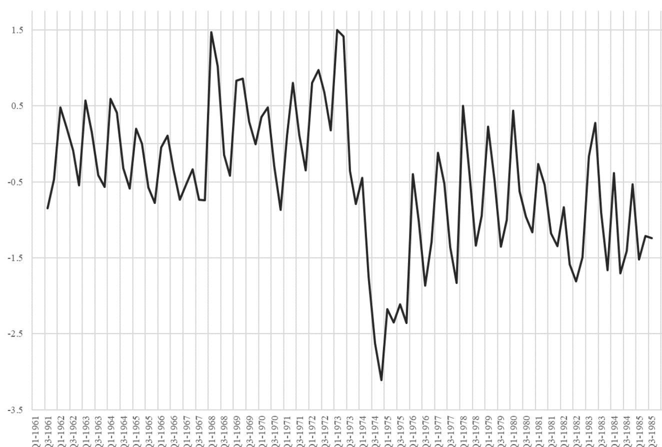


Figure 3.14: Quarterly current account-to-nominal GDP ratio, 1961-1985. (Source: Department of Statistics)

Despite some worsening indicators around the New Zealand economy over the 1980s, Morris and Shin's narrative does not perfectly explain the New Zealand experience in 1984. Key indicators on the fundamental state of the economy — such as GDP, unemployment, and lending — had worsened briefly between 1980 and 1983, but were improving during the lead-in to the 1984 currency crisis, as in

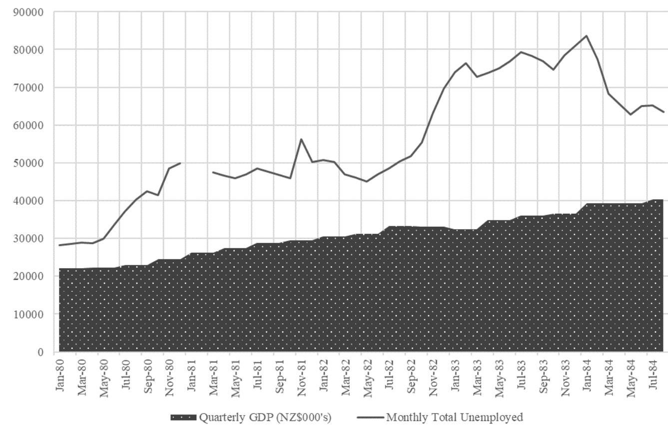


Figure 3.15: Quarterly GDP and monthly unemployed, 1982 to 1984. (Source: Department of Statistics and RBNZ Bulletins)

Figure 3.16: Year-on-year change in months deposits for trading banks, and monthly portion of lending limits used by trading banks (NZ$000's), 1982-1984. (Source: RBNZ Bulletins)

Figures 3.14, 3.15, and 3.16. Although New Zealand's current account had become persistently negative after 1973, the balance seen in 1984 was at comparable levels to the deficit seen in 1981 and 1982. The speculative attack seen in 1984 did not emerge in response to an announcement made on the fundamental state of the economy, and Morris and Shin's model is therefore an inadequate reflection of the New Zealand experience.[18]

[18]Singleton (2006) and Easton (2009) also relevantly describe the quick diffusion of information

3.3.1.5 Contagious currency crises

Contagious currency crises are an extension to Obstfeld's second-generation currency crisis model that deals with the increased likelihood of currency crises occurring in a domestic country if foreign countries have recently experienced their own speculative attacks. Early papers in this area are influenced by the sequence of currency crises seen in the European exchange market over 1992-93, and there are accordingly two "types" of theoretical models that approach the nature of this contagion.

The first type deals with the "mechanical" aspect of currency crises, such as in Gerlach and Smets (1995), where the devaluation of a foreign currency leads to a decline in domestic competitiveness through the relative price of domestic imports, which in turn leads to a declining domestic trade balance and the devaluation of the domestic currency. The second type deals with the "information" channel of currency crises. Eichengreen, Rose, and Wyplosz (1996) draw attention to an interpretation of Caplin and Leahy (1994) where the devaluation of a neighbouring currency can form self-fulfilling expectations of weakness in the domestic currency, resulting in a domestic currency crisis. Both "types" of contagion can be useful to explain how currency crises spread between countries or regions, such as in East Asian countries throughout the late 1990s.

There is a strong argument that New Zealand's 1984 currency crisis, and in fact many of New Zealand's prior devaluations, were the result of contagion from prior devaluations of the Australian (or UK) exchange rate. There are two possible "types" of transmission that can cause the contagion of a currency crisis from one country to another: "mechanical" crises that are transmitted through trade

concerning the RBNZ's balance sheet during the onset of the 1984 speculative attacks, which suggests the failure of Morris and Shin's prerequisite for "incomplete information" (although there was some uncertainty around certain policy decisions, such as when the price, wage, and rent freezes would end).

imbalances, such as in Gerlach and Smets (1995), and "information" crises that are transmitted through market expectations, as in Caplin and Leahy (1994).

Australia and New Zealand Trade Volumes: 1982-1984

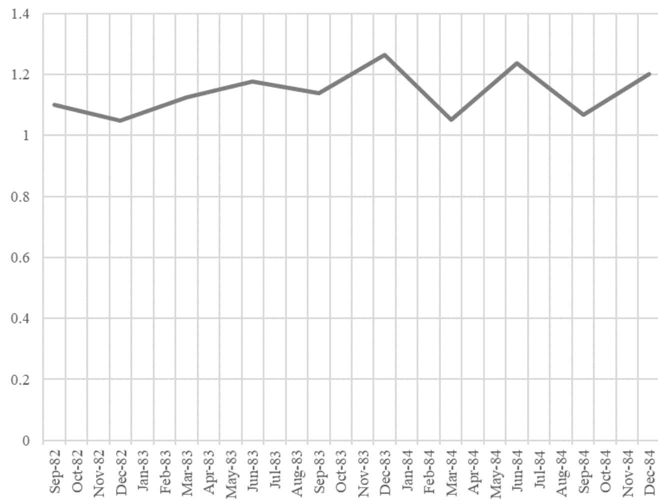


Figure 3.17: Ratio of quarterly export-to-import volume index for Australia and New Zealand, 1982-1984. (Source: Department of Statistics, June 2002 Quarter Base = 1000)

From figure 3.17, we can see that the ratio of export to import volumes between Australia and New Zealand did not significantly change following the Australian devaluation of 1983, which is most likely a result of New Zealand's immediate 6% devaluation on 8 March that restored New Zealand's competitiveness with the Australian market and diffused the "mechanical" contagion forces before they could culminate in the 1984 speculative attack.

With regard to the "information" channel of contagious currency crises, the Australian snap election and subsequent devaluation in 1983 may have played a role in forming market expectations during New Zealand's snap election and subsequent devaluation in 1984, although these expectations are closely linked to Rother's (2009) election-led currency crises, and are discussed in greater detail in the following sub-section.

3.3.1.6 Electoral cycles and currency crises

Rother (2009) builds on Meon (2001) and Meon and Rizzo (2002) to introduce political elections to second-generation currency crises, as influenced by the Argentinian currency crisis that councided with a controversial election at the close of 2001.

Rother builds a model with two political parties: the opposition, who is in favour of devaluation and wins the upcoming election with probability p, and the incumbent, who favours defending the currency and wins with probability $(1-p)$. The election is repeated at intervals, with term length M, and immediately after each election the winning party commits to their exchange rate policy of choice for the remainder of their term. As p increases and the opposition party (which favours devaluation) becomes more likely to win, the incumbent party is faced with stronger devaluation expectations, and becomes more likely to experience a currency crisis. Rother also finds that a country becomes more exposed to the possibility of a currency crisis if they have shorter term lengths, as more frequent elections lead to more frequent opportunities for the opposition party to challenge the incumbent's fixed exchange rate regime.

This narrative closely matches the New Zealand experience, as speculators immediately began to withdraw assets after the announcement of a snap election on 14^{th} June, which created the opportunity for the election of the Labour government that favoured devaluation. The only point of difference between Rother's narrative and the New Zealand case is that the incumbent government of Rother's theoretical model is forced to devalue the currency before the election date while, in New Zealand, the incumbent National government successfully resisted devaluation pressures and instead the incoming Labour government was forced to devalue after winning the election. This narrative captures an aspect of emerging economy currency crises as identified empirically by Frankel (2005), where an incumbent government will attempt to delay a devaluation until after an upcoming election so as to "lay the blame" on the incoming government for any economic and other negative impacts.

Importantly, the coordination of the speculative attack from 15$^{\text{th}}$ June, the day after the election, occurred at a time when New Zealand had already been experiencing a persistent increase in short-term interest rates over government stock offerings, which implies that the New Zealand exchange rate was already at risk of a second-generation currency crisis as the election was announced. Rother's model of election-led currency crises therefore sheds light on the specific timing of the withdrawal of domestic assets, while the long-term factors that opened New Zealand to the possibility of an attack included the erosion of official foreign reserves, and increased expectations of a devaluation by speculators.

Rother's model of election-led currency crises can also be compared to Caplin and Leahy's (1994) model of contagious speculation, to suggest how speculators formed expectations of a devaluation by the incoming Labour government. The Australian currency crisis experience of 1983 reads very similarly to the 1984 New Zealand crisis, with the announcement of a snap election sparking a run on official foreign reserves and a devaluation by an incoming Labour government, and this similarity was explicitly noted by several RBNZ officials during the course of New Zealand's speculative attack (RBNZ, 1984). These similarities more than likely helped speculators to shape their expectations over the outcome of New Zealand's upcoming election, and hastened the onset of the 1984 crisis.

Finally, a key insight of Rother's (2009) model of election-led currency crises is that currency crises of this nature become more prevalent as the length of the election term decreases, on account of the opposition party having more frequent opportunities to "challenge" the incumbent fixed exchange rate regime. New Zealand has an election term of three years, which is one of the shortest election terms in the world over the executive branch of leadership. This may have contributed to New Zealand's 1984 crisis following the announcement of the snap election on 14$^{\text{th}}$ June, as this announcement further "shortened" the time between ordinary elections.

3.3.1.7 Vested interest currency crises

Rother (2009) also extends Neugart (2003) to consider the relationship between political lobbying and currency crises, drawing inspiration from political trends in the UK and France during the Gold Standard era, and also during the Mexican crisis in 1994-1995.

In Rother's model, a lobbying group offers financial compensation to the government in exchange for lower taxes (recall that the government chooses between devaluing the currency, increasing the money supply, or increasing the tax rate to address fiscal deficits as they arise), which in turn leads to reduced pressure for a nominal devaluation in the currency, and an overvaluation of the domestic currency. The lobbying group continues to finance these payments to the government using the reduced taxes it has previously enjoyed. However, if the lobbying group disbands, changes their preferences over the exchange rate regime, or if the government becomes less susceptible to accepting lobbying pressures, then the exchange rate decision by the government is no longer skewed to resist a nominal devaluation, and the economy becomes more susceptible to a currency crisis.

The events of the 1957 balance of payments and the resulting introduction of widespread import licenses led to the growth of import lobbying groups such as the Manufacturers Federation. The growth of political groups to lobby against a nominal devaluation in New Zealand closely follows the commentary of Harvey (2004), who notes that the introduction of some policies (such as an import license) will grant monopoly profits to a unique sector of the economy that then uses those profits to ensure the policy's continuation. Following the re-introduction of import licences in 1957, importer lobbying groups such as the Manufacturers' Federation grew in considerable size and political power in New Zealand due to the monopoly profits granted by zero-cost import licenses.

However, the unification and lobbying strength of members within the Manufacturers' Federation declined during the early 1980s as capital ownership intensified and New Zealand's manufacturing exporters began to favour devaluation (Roper, 1992). Other lobbying groups, such as the Retailers' Federation, similarly began to weaken their stance against a nominal depreciation during the early 1980s. The announcement in April 1984 that import licenses would be replaced with tariffs over the coming years, could be seen as a change in the extent to which New Zealand's import lobbying groups were willing or able by in defence of the fixed exchange rate regime, which suggests in turn that New Zealand become more exposed to the possibility of a currency crisis in early-1984.

3.3.2 Insights from the 1984 crisis

This final section draws together some lessons and insights from the theoretical models that best compare to New Zealand's currency crisis experience, and then goes on to identify some gaps in the theoretical currency crisis literature.

3.3.2.1 The importance of political economy

Rother's (2009) model of election cycles and currency crises, which describes the New Zealand experience well, suggests that a shorter electoral term leads to greater opportunities for successive governments to challenge the longevity of a fixed exchange rate regime. This insight could be extended to other ongoing policies that are exposed to speculator expectations for their continuation, and suggests that New Zealand – which has one of the shortest executive terms in the world, with three years between each election — may be exposed to greater volatility and uncertainty over controversial regimes.

In addition, Rother highlights the importance of vested interests that can lead to persistent, long-term imbalances if short-term policy decisions are delayed. New Zealand's exchange rate became considerably overvalued in the mid-20th century, alongside the rise of powerful lobbying groups such as the Manufacturers' Federation that benefited from import restrictions and an overvalued nominal exchange rate regime. Had these groups not grown following the re-introduction of import licenses from 1957, the New Zealand exchange rate might not have suffered the same degree of overvaluation, and the 1984 currency crisis (and the resulting burden of foreign-denominated debt, which increased in relative value with the 20% devaluation) may not have imposed as heavy a cost on the New Zealand economy.

Beyond the political economy insights of Rother, models of currency crisis contagion such as Caplin and Leahy (1994) suggest that repeatedly devaluing the New Zealand dollar in response to Australian devaluations may have contributed to the development of devaluation expectations, as speculators expected the New Zealand government to "copy" Australia's election-led devaluation when New Zealand called for its own snap election in 1984. This highlights the potential dangers of international policy coordination. There is a risk that speculator expectations can drive the success of future economic-policy execution, if New Zealand policymakers form a "reputation" for mirroring the decisions of contemporary governments.[19]

A final insight from this analysis of Zealand's 1984 currency crisis is that the policy actions taken by Prime Minister Muldoon's National Government between 1982 and 1984 did successfully delay the realisation of a "first-generation" or fundamental currency crisis, but could not have delayed the crisis indefinitely. The expectation that price, wage, and rent freezes would eventually be removed led speculators in New Zealand to expect that there would be a realisation of

[19]This reputation becomes more significant as the size and nature of New Zealand's capital markets become more distinct from Australian markets. Although an argument could be made that New Zealand's capital markets at the time of the 1984 currency crisis were small enough to be "dwarfed" by Australian policy decisions, this argument less likely to be the case today.

unaddressed pressures and a reversion to a more flexible exchange rate regime, rather than suppressing these expectations altogether.

3.3.2.2 Theoretical research on currency crises

Aside from the role that the 1984 snap election played in forming expectations over New Zealand's June-July currency crisis, there is a small gap in the literature around the role of the wages and incomes policy in New Zealand's currency crisis narrative. The 1982 price freeze created a build up of inflationary pressures in New Zealand, which resulted in an unrealised deterioration in the competitiveness of New Zealand's exporting industries. The expectation that the price freeze may come to an end also shaped market expectations for a devaluation due to the realisation of these inflationary pressures.

A complete model of the New Zealand currency crisis might therefore incorporate a mechanism around the delayed deterioration in the domestic trade balance, to introduce the price freeze to a "mechanical" model of contagious currency crises, as well as considering the role that the general price freeze (or more general institutional factors) played in forming the "information" channel of crisis contagion.

3.4 Conclusion

New Zealand faced a severe currency crisis in 1984 that paved the way for a period of intense reform and economic liberalisation. Although this period of reform has been given a great degree of attention by authors, there has been little consideration of the theoretical underpinnings of the currency crisis itself.

New Zealand's 1984 currency crisis was the culmination of a long period of overvaluation in the nominal New Zealand dollar, as well as rising government debt and gradual liberalisation of New Zealand's trade and exchange accounts, which left the New Zealand economy vulnerable to a speculative currency attack. A comparison with selected currency crisis models reveals that the New Zealand experience best compares to second-generation theoretical crises of self-fulfilling market expectations, with the announcement of a snap election encouraging speculators to coordinate and attack the New Zealand dollar assets between 14$^{\text{th}}$ June and 13$^{\text{th}}$ July 1984.

New Zealand's experience reveals the importance of historical policy decisions and institutions (especially domestic capital market institutions) in influencing the expectations of domestic speculators. The series of nominal adjustments to the New Zealand dollar in response to adjustments in the Australian dollar may have helped speculators form expectations of a New Zealand devaluation in 1984 due to the similarities in contexts with Australia's currency crisis in 1983. New Zealand's policy decisions concerning the role of import licenses and export promotion schemes also led to the growth of powerful domestic lobbying groups that delayed the nominal devaluation of the New Zealand dollar prior to 1984, shedding light on the importance of identifying the biases and incentives of lobbying groups wherever they may arise, so as to avoid costly adjustments later on.

On balance, the 1984 crisis in New Zealand resolved a long-standing overvaluation in the New Zealand dollar, and helped pave the way for an improvement in New Zealand's export competitiveness that we continue to benefit from today. Future research in this area could include the complete construction of a historic real effective exchange rate for New Zealand, as the current BIS (2006) model extends only to 1964. Other theoretical research on currency crises could include consideration of the impact of wages and incomes policies in the unfolding of a self-fulfilling currency crisis.

Chapter 4

Macro-prudential Policy, Monetary Policy, and Leaning Against the Wind

4.1 Introduction

The use of monetary policy to address financial stability — a central bank policy response known as "leaning against the wind" — has become increasingly common following the global financial crisis of 2008.[1] Prominent central banks, such as the Bank of England, have begun to specifically identify financial stability as a secondary objective of monetary policy in addition to the traditional primary objective of price stability.[2] This dual mandate within central banks has naturally given rise to considerable debate on the benefits and drawbacks of leaning against the wind.

[1] A version of this chapter is under consideration by New Zealand Economic Papers, and as of July 2020 has the status of "revise-and-resubmit". This chapter incorporates the comments of the two anonymous journal referees.

[2] The two most recent Remits for the Monetary Policy Committee explicitly allow inflation to deviate from its target level in order to pursue financial stability (Carney, 2014; Carney, 2020).

The benefits of leaning against the wind are identified by Disyatat (2010), Stein (2012), and Woodford (2012), who note that a failure to consider financial stability can negatively impact a central bank's price stability objective.[3] However, these papers do not consider the existence of a separate, dedicated instrument — such as macro-prudential policy — that could address financial stability concerns without the need for monetary policy intervention. Analyses that do consider macro-prudential regulation typically begin with an assumption that macro-prudential policy is an inefficient or otherwise flawed instrument, thereby justifying the use of monetary policy to achieve a broader financial stability mandate (e.g. IMF, 2013; Stein, 2013; Adrian and Liang, 2014; Cecchetti and Kohler, 2014).

Some commentators (such as Ueda and Valencia, 2014; Svensson, 2017), suggest that in the presence of a dedicated macro-prudential regulator, a central bank with a secondary objective of financial stability may unnecessarily sacrifice their primary objective of price stability. Smets (2014) also argues that leaning against the wind can negatively impact the macro-prudential regulator. In contrast, others focus on the effect that the macro-prudential regulator has on the central bank (e.g. Angelini et al., 2012; Agenor et al, 2013; Collard et al, 2017; Aikman et al, 2019). In Smets' model, the expectation that the central bank can resolve a portion of financial instability using monetary policy at a later point in time will encourage the regulator to "ease" their financial regulations in favour of broader economic outcomes, a result which forsakes the pre-monetary policy (*ex-ante*) financial stability of the economy.

Importantly, models such as Ueda and Valenica (2014) and Smets (2014) are built on the assumption that macro-prudential policy is selected efficiently and without distortions. Smets (2014), in particular, points to the "easing" effect of leaning against the wind on macro-prudential policy as a strictly negative outcome.

[3]Other notable papers in this area include Agur and Demerzis (2013), Gambacorta and Signoretti (2013), Ajello et al. (2016), and Gourio et al. (2016), who consider financial stability objectives such as credit, asset prices, and crisis probabilities.

However, if the macro-prudential regulator was subject to existing distortions that encouraged them to *over-react* to changes in financial conditions, then the "easing" induced by a central bank that leans against the wind could result in an improvement of the macro-prudential policy rule and, therefore, an improvement in *ex-ante* financial stability.

In this chapter, I explore the question of whether leaning against the wind by a central bank can have a positive impact on the *ex-ante* conduct of macro-prudential policy by "correcting" an existing distortion in the regulator's policy rule. I extend the Smets (2014) framework to allow for two types of macro-prudential uncertainty, building on recent ideas by Bahaj and Foulis (2017).

Bahaj and Foulis (2017) introduce "instrument uncertainty" in the sense of Brainard (1967), describing a policy instrument that has a volatile relationship with its target objective. If instrument uncertainty is high, then a macro-prudential regulator is less responsive to changes in financial conditions. This is because the regulator becomes hesitant to contribute to further volatility in the economy by using a volatile instrument.

Bahaj and Foulis (2017) also allow for model uncertainty in the spirit of Hansen and Sargent (2008) to describe a misspecification in the macro-prudential regulator's model of financial conditions. They demonstrate that misspecifications can lead the regulator to over-react when selecting macro-prudential policies, as the regulator mistakenly believes that the prevailing financial conditions require a significant change in their policy stance. The extent of the model misspecification depends on the risk-sensitivity of the regulator. A macro-prudential regulator that is highly risk-sensitive is more acutely aware that their model of financial conditions may be incorrect, and will therefore exert more "effort" to correct their model and reduce the misspecification. It follows, then, that a regulator who is not risk-sensitive, and who is accordingly faced with a significant misspecification in their model, will over-react to changes in financial conditions.

By introducing these two forms of uncertainty into the Smets (2014) framework, I am able to capture a "profile" of the regulatory framework using the degree of instrument volatility and the extent of the regulator's risk-sensitivity. This is useful to reflect on the different outcomes of leaning against the wind between countries (where, for example, the sophistication of the financial market may affect instrument volatility), or across time (where, for example, the risk-sensitivity of a macro-prudential regulator may be affected by institutional arrangements).

To capture this narrative, I begin with Smets' simple model of monetary and macro-prudential policy without distortions and consider a case where the central bank does not lean against the wind. I first introduce instrument uncertainty as volatility in the regulator's macro-prudential instrument, before allowing for model uncertainty as a misspecification term that is inversely proportional to the risk-sensitivity of the regulator. I then allow the central bank to lean against the wind, in order to determine whether such a policy improves or worsens the macro-prudential regulator's policy rule in comparison to the baseline "best practice" case.

My key finding is that leaning against the wind improves the regulator's policy rule, and therefore improves *ex-ante* financial stability, provided the macro-prudential regulator is already over-reacting to the true nature of financial conditions in the economy. This will only be the case if the regulator is characterised by a low level of risk-sensitivity, and is using an instrument that has a low level of volatility (i.e. the regulator has high model uncertainty, but low instrument uncertainty).

The analysis offers a middle-ground between authors such as Ueda and Valencia (2014) and Smets (2014), who find that leaning against the wind is undesirable, and authors such as Cecchetti and Kohler (2014), who suggest the opposite. The construction of my model incorporates one of the main critiques against macro-prudential policy, namely that the policy has an inherent inefficiency or distortion that legitimises allowing monetary policy to "step in" and cover the shortfall (as in Roisland's (2017) consideration of instrument uncertainty). I find instead that the existence of a distortion to the macro-prudential regulator is insufficient to justify leaning against the wind when considering *ex-ante* conditions for financial stability. Rather, the nature and direction of the distortion is key in informing a central bank's decision to lean against the wind.

The chapter is arranged as follows. First, I outline the theoretical model in detail, before discussing the results and some implications for designing central bank policy around financial stability objectives when there may be a positive or negative impacts on the *ex-ante* macro-prudential policy rule.

4.2 Model

4.2.1 Baseline Model

In the baseline or "certainty equivalent" model, macro-prudential policy is not subject to any distortions from policy uncertainty. The policy rule in this case serves as the optimal benchmark against which subsequent extensions will be compared.

The three objectives for the policymaker are: price stability, $(\pi^* - \pi)$; output stability, $(y^* - y)$; and financial stability, $(\theta^* - \theta)$, where θ is real leverage (a common proxy for the financial stability objective). Terms with asterisks represent "target" levels of price, output, and leverage respectively.

In the baseline model, inflation, π, and macro-prudential policy, δ, are selected by the central bank and the macro-prudential regulator respectively.[4] Following Smets (2014), the macro-prudential authority selects optimal policy first, and the monetary authority follows. This reflects a key facet of reality, as macro-prudential

[4]This model does not require a strict separation of the central banker and the macro-prudential regulator, but rather focuses on the design of policy targets within or between the institution(s).

policy is selected less regularly than monetary policy and can appropriately be seen as a "pre-condition" for the more frequent selection of monetary policy (for other examples, see Cecchetti and Kohler, 2014, and De Paoli and Paustian, 2017).

In what follows, the parameter δ is a policy instrument that captures the "effect" of macro-prudential instruments on the economy. For example, an increase in macro-prudential capital requirements would be modelled by a *negative* value of δ, as the tighter limits on bank lending leads to *decreased* leverage in the economy. Accordingly, the macro-prudential policymaker selects δ to minimise the loss function:

$$L^M = \frac{1}{2}(\theta^* - \theta)^2 + \frac{a}{2}(y^* - y)^2$$

where the parameter a describes the extent of the macro-prudential regulator's concern for a secondary objective other than financial stability, such as output stability.

The central bank then selects the inflation rate, π, to minimise the loss function:

$$L^{CB} = \frac{1}{2}(\pi^* - \pi)^2$$

The financial leverage parameter, θ, is assumed to take the form:

$$\theta = \bar{\theta} - (\pi - \pi^e) + \delta \tag{4.1}$$

where $\bar{\theta}$ is the natural (or average) level of real leverage, δ is the macro-prudential position selected by the policymaker, and $(\pi - \pi^e)$ is the "debt-deflation" impact of unexpected inflation.[5]

Output is given by:

$$y = \bar{y} + \alpha(\pi - \pi^e) + \beta\delta \tag{4.2}$$

[5]Ueda and Velencia (2014) show the "debt-deflation" of nominal leverage as normalised by real output, demonstrating how surprise inflation erodes the real value of leverage to an economy.

where $\bar{y}$ is the natural (or average) level of output, and $\alpha > 0$ is the slope of the Phillips curve with respect to unexpected inflation, $(\pi - \pi^e)$. The term $\beta > 0$ captures the extent to which macro-prudential policy has a real output impact on the economy.[6]

As in Smets (2014), the monetary authority does not (directly) consider output in its' execution of monetary policy. The issue of traditional time-inconsistency with respect to output is not the key focus of this chapter.

The macro-prudential regulator selects δ to minimise its loss function, L^M, subject to leverage (4.1), and output (4.2). The first-order condition is given by:

$$\delta = \frac{(\theta^* - \bar{\theta}) + a\beta(y^* - \bar{y})}{1 + a\beta^2} \tag{4.3}$$

Similarly, the central bank selects π to minimise its loss function, ^{CB}:

$$\pi = \pi^* \tag{4.4}$$

The monetary policymaker selects inflation to meet its target, π^*. The macro-prudential regulator, by contrast, balances deviations from the target level of leverage, θ^*, and departures from the natural level of output, y^*. The weighting a associated with the regulator's concern for real output shapes the choice of δ in equilibrium. If $a = 0$, the macro-prudential regulator will select $\delta = (\theta^* - \bar{\theta})$ to only address deviations from the leverage target.

Solutions (4.3) and (4.4) are equivalent to the first stage of Smets' (2014) model, and are considered the "best case" policy responses. Solution (4.3) in particular captures the optimal *ex-ante* macro-prudential rule to achieve financial stability before any intervention from a central bank is possible. In other words, solution (4.3) reflects the "true" leverage gap that the macro-prudential regulator would address in the absence of distortions due to policy uncertainty or leaning against the wind.

[6] This link between macro-prudential policy and output is intuitive. An expansionary macro-prudential position (for example, as with reduced capital requirements) can stimulate business activity through increased lending to the real economy (Behn et al., 2016).

4.2.2 Instrument Uncertainty

Instrument uncertainty reflects the volatility of the macro-prudential instrument, and is captured by a variance term in the marginal impact of that instrument. Brainard (1967) demonstrates that policymakers with a volatile instrument are less inclined to use this instrument due to the potential for increasing economic volatility. Arguably, policymakers have had limited experience with macro-prudential policy, and the medium- and long-term implications of macro-prudential instruments are still not properly understood (IMF-FSB-BIS, 2016; Buch et al., 2018). A complex regulatory system can also contribute to heterogeneous responses between sectors of the financial market, which can contribute to increased volatility and uncertainty around the impact of macro-prudential regulation (Altunbas et al., 2017).

The volatility or "instrument uncertainty" of macro-prudential policy is captured by variance in the slope of the macro-prudential instrument:

$$\delta = d\delta^i + u; d \sim N(\bar{d} > 0, \sigma_d^2), u \sim N(0, \sigma_u^2) \tag{4.5}$$

where δ^i is the value of macro-prudential policy under instrument uncertainty, $\bar{d}$ is the slope (or the average marginal impact) of the macro-prudential instrument, and σ_d^2 is the variance of this slope.

The macro-prudential regulator selects δ to minimise its loss function, L^M, subject to the model equations (4.1) and (4.2), and the new instrument uncertainty condition, (4.5). Optimal policy, evaluated at its expected value, is given by:

$$\delta^i = \frac{(\theta^* - \bar{\theta}) + a\beta(y^* - \bar{y})}{(\bar{d} + \sigma_d^2)(1 + a\beta^2)} \tag{4.6}$$

The central bank then selects π to minimise its loss function, ^{CB}:

$$\pi^i = \pi^* \tag{4.7}$$

In contrast to the baseline result in section 2.1, macro-prudential policy is now shaped by its average slope, $\bar{d}$, and by the extent of volatility or instrument uncertainty, σ_d^2. As instrument uncertainty increases, the macro-prudential regulator becomes more conservative when changing macro-prudential policy in response to the leverage gap. Formally,

$$\frac{\partial \delta^i}{\partial \sigma_d^2} = -\frac{(\theta^* - \bar{\theta}) + a\beta(y^* - \bar{y})}{(\bar{d} + \sigma_d^2)^2(1 + a\beta^2)} < 0$$

This is the same result as the classic Brainard model, where the regulator does not want to contribute to volatility in the economy, and risk deviating further from the financial stability target, by using a volatile instrument.

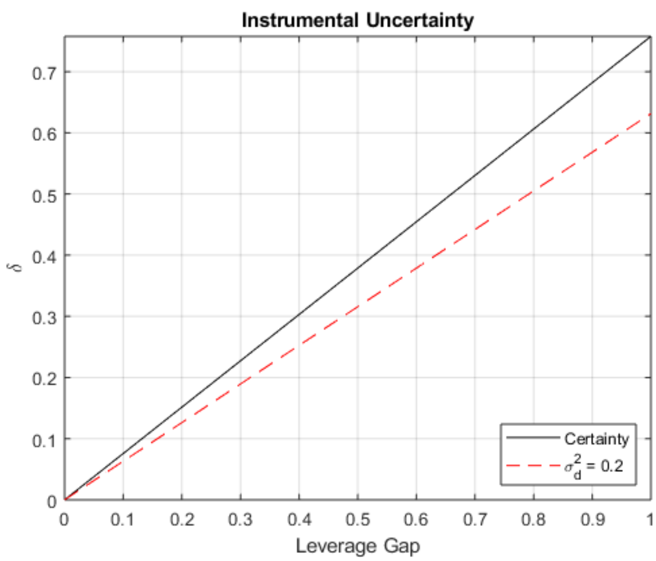


Figure 4.1: Instrument uncertainty with $\sigma_d^2 = 0.2$, compared to certainty equivalence $\sigma_d^2 = 0$, when $a = 0.5$, $\beta = 0.8$, $\bar{d} = 1$, $\alpha = 0.8$, and $(y^* - y) = 0$ (i.e. there is no output gap. The distortion to macro-prudential policy is entirely due to biases affecting the financial objective).

Figure 4.1 illustrates this outcome in a simple case where there is insufficient leverage in the economy (i.e. $(\theta^* - \bar{\theta}) > 0$). The distortion induced by instrument uncertainty causes the regulator to be cautious when loosening their macro-prudential position, and ultimately the regulator does not increase leverage sufficiently to achieve *ex-ante* financial stability in the economy.[7]

[7] In Roisland (2017), the monetary authority may step in at this point and use monetary policy

Certainty Equivalence The baseline setting outlines the "certainty equivalent" policy rule, (4.3), where δ is chosen according to the true value of the leverage gap. The macro-prudential regulator can approximate this rule if the slope of (4.4) is equal to the slope of the instrument uncertainty policy rule, (4.6):

$$\frac{1}{1+a\beta^2} = \frac{1}{(\bar{d}+\sigma_d^2)(1+a\beta^2)}$$

In a model of instrument uncertainty, the macro-prudential regulator would only achieve certainty equivalence if there was *no* instrument uncertainty, i.e. $\sigma_d^2 = 0$. For any other value of σ_d^2, the regulator would consistently be more cautious when using their macro-prudential instrument, and would leave an unresolved overhang in the leverage objective.

4.2.3 Model Uncertainty

Model uncertainty concerns the accuracy of the regulator's model of financial conditions (in contrast to instrument uncertainty, which deals with the volatility of the macro-prudential instrument), and is captured by a misspecification or distortion in the regulator's estimation of the leverage gap.[8]

Consider a simplified version of Hansen and Sargent's (2008) two-stage process for incorporating model uncertainty. In the first stage, a representative player "Nature" predetermines the size of the model misspecification subject to an exogenous "risk-sensitivity" constraint. In the second stage, the macro-prudential policymaker selects their optimal policy, followed by the central bank who minimises loss over the price stability objective in an additional third stage of the model. The timeline of events is summarised in Table 4.1.

to "lean against" the residual gap in the financial objective. However, this does not improve the *ex-ante* or "pre-central bank" policy rule for macro-prudential policy, which is the key consideration of my chapter.

[8] An example of model uncertainty can be seen in the DSGE banking stress-test models that inform regulators on the resilience of financial institutions, and therefore inform the need for macro-prudential regulation. Many prominent authors, such as Drehmann, Borio, and Tsatsaronis (2012) and Stiglitz (2018), have heavily critiqued these models for their inability to identify *ex-ante* imbalances, and for the sensitivity of these models to parameter calibrations.

Stage 1	Stage 2	Stage 3
"Nature" selects model misspecifications, v, subject to regulator risk-sensitivity, Ω	Regulator selects macro-prudential policy, δ, to minimise leverage and output deviations	Central bank selects monetary policy, π, to minimise price deviations

Table 4.1: Timeline of events with both instrument and model uncertainty.

There are two key elements in this process: (a) the distorting misspecification that model uncertainty introduces in the regulator's model of financial conditions, and (b) the degree to which the macro-prudential regulator is sensitive to the potential of this distortion.

The first element, the distortion that arises due to model uncertainty, is inspired by the Knightian concept of the "unknown unknown" (Knight, 1921), and is captured by a fundamental model misspecification, v, in the regulator's estimation of the leverage gap (noting that macro-prudential policy is here denoted δ^m):

$$\theta = \bar{\theta} - (\pi - \pi^e) + (\bar{d} + \sigma_d^2)\delta^m + v \tag{4.8}$$

Due to the misspecification, the regulator will measure the size of the leverage gap as the distance between θ^* and $\bar{\theta} + v$, rather than the *true* size of the leverage gap, which is the distance between θ^* and $\bar{\theta}$. The regulator is now misinformed as to the state of financial conditions, and will therefore choose an inappropriate policy response when "minimising" the loss function. In practise, v could reflect a misspecified DSGE model, or incomplete information about leverage and financial activity in the market.

The second element of model uncertainty is the extent to which the regulator is sensitive to the potential of a model misspecification. Hansen and Sargent (2008) describe this phenomenon as "risk-sensitivity", which is captured by the parameter

$\Omega > 1$.[9] An increase in Ω indicates that the regulator is more sensitive to the possibility that their estimation of leverage could be distorted by a misspecification in the model. In practise, a high Ω would be characterised by a model-conscious regulator who is aware of the short-comings of their modelling capabilities.

These two elements of model uncertainty interact in the first stage of the model uncertainty process, where a malevolent representative player "Nature" selects the size of the model misspecification that will maximise loss to the economy.[10] To prevent an unrealistic and infinitely misspecified model, the value of v is constrained by the regulator's risk-sensitivity term, Ω.

The intuition behind the regulator's "risk-sensitivity" constraint is that if the macro-prudential regulator is very sensitive to the possibility of a model misspecification, and Ω is high, then the regulator would be characterised by the incentive to invest in greater technologies that improve their estimate of leverage (for example, by ensuring greater efficiency of information gathering, or improving the quality of modelling through technical resources). The misspecification distortion is reduced, and the size of v decreases.

Formally, in the first stage of the min-max framework, the representative player "Nature" selects v to maximise loss, L^N, subject to (4.8):

$$L^N = \frac{1}{2}(\theta^* - \theta)^2 - \frac{\Omega}{2}v^2$$

where the first term of the loss function represents "Nature" distorting the regulator's leverage model, and the second is the "constraint" of the macro-prudential regulator's risk-sensitivity. As Ω increases, the regulator's heightened risk-sensitivity reduces the possible extent of the model misspecification, v.

[9] Although Ω is treated as exogenous in this model, others (such as Tallarini, 2000) have explored the possibility of an endogenous risk-sensitivity term. In these cases, an endogenous increase in risk-sensitivity increases the accuracy of the regulator's models, and decreases the extent of model misspecifications.

[10] This min-max approach is based on the robust control literature, where the misspecification term, v, is more commonly known as "entropy". The maximisation of loss by a malevolent player is common practise in this literature, as it ensures that the interaction between the policymaker and nature reflects the most averse conditions.

To maximise loss through L^n, "Nature" selects:

$$v = \frac{(\bar{d} + \sigma_d^2)\delta^m - (\theta^* - \bar{\theta})}{\Omega - 1}$$

As risk-sensitivity, Ω, increases, the model misspecification, v, decreases to reflect how a regulator who is sensitive to model misspecifications will have a more accurate model due to smaller actual misspecifications.

After "Nature" selects the worst-case misspecification, the macro-prudential regulator selects δ^m to minimise loss over leverage and output deviations (as in the simple objective function, L^M), subject to output, (4.2), and the new expression for leverage, (4.8). The misspecification term, v, is taken as given. This yields:

$$\delta^m = \frac{(\theta^* - \bar{\theta}) + a\beta(y^* - \bar{y}) - v}{(\bar{d} + \sigma_d^2)(1 + a\beta^2)}$$

In the third and final stage of the model, the monetary authority minimises their loss function, L^{CB}, yielding the optimal choice of inflation:

$$\pi = \pi^*$$

In a Stackelberg equilibrium, the size and nature of the model misspecification is given by:

$$v = -\frac{a\beta^2(\theta^* - \bar{\theta}) - a\beta(\bar{d} + \sigma_d^2)(y^* - \bar{y})}{(\bar{d} + \sigma_d^2)\Omega + a\beta^2(\Omega - 1)} \tag{4.9}$$

while optimal macro-prudential policy rule is given by:

$$\delta^m = \frac{\frac{\Omega}{\Omega - 1}(\theta^* - \bar{\theta}) + a\beta(y^* - \bar{y})}{(\bar{d} + \sigma_d^2)(\frac{\Omega}{\Omega - 1} + a\beta^2)} \tag{4.10}$$

The model misspecification, v, is negative in the leverage gap. This means that the nature of the distortion to the regulator's model causes the regulator to incorrectly estimate leverage as being further from its' target value of θ^*, rather than closer. For example, if there is insufficient leverage in the economy and $\theta^* > \bar{\theta}$, then the misspecification term, v, will cause the regulator to estimate a larger θ^*, or a smaller $\bar{\theta}$, than what truly represents the economy. This speaks to a regulator who, for example, has miscalibrated a financial stability model to suggest that exceptionally high leverage is optimal.

If the macro-prudential regulator addresses the leverage gap suggested by their distorted model, then they will be executing a larger, more aggressive change in the macro-prudential instrument than is actually necessary to resolve the true value of the leverage gap. This result is reflected in the macro-prudential regulator's policy rule, (4.10), which shows that the selection of δ^m is subject to a new term, $\frac{\Omega}{\Omega-1} > 1$. This term over-weights the size of the leverage gap when selecting macro-prudential policy, which means that the regulator will select a larger value of macro-prudential policy, δ^m, than the value that is necessary to resolve the true *ex-ante* leverage gap, δ. This can also be seen in Figure 4.2, in the case where there is insufficient leverage in the economy (i.e. $\theta^* > \bar{\theta}$). Risk-sensitivity here is $\Omega_m = 2$, and there is no instrument uncertainty (i.e. $\sigma_d^2 = 0$).

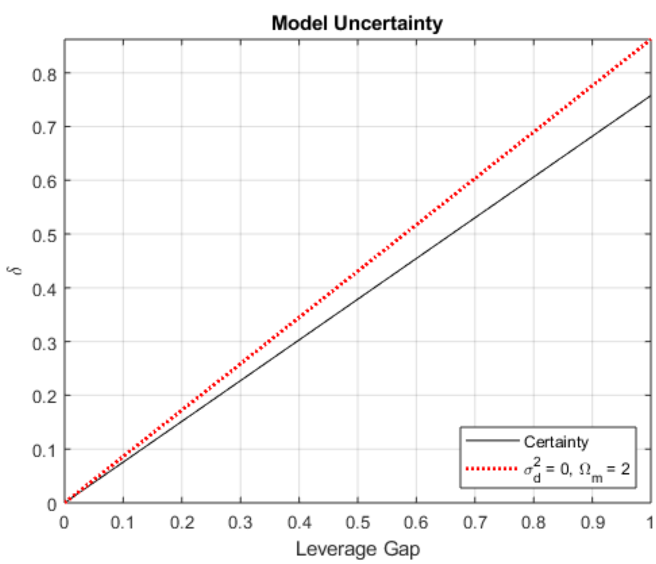


Figure 4.2: Model uncertainty when risk-sensitivity, $\Omega = 2$ and instrument uncertainty $\sigma_d^2 = 0$, compared to certainty equivalence $\Omega =$, when $a = 0.5$, $\beta = 0.8$, $\bar{d} = 1$, and $(y^* - y) = 0$.

Importantly, the degree to which the regulator over-weights the leverage gap, $\frac{\Omega}{\Omega-1} > 1$, is inversely proportional to the regulator's risk-sensitivity, Ω. Formally,

$$\frac{\partial \delta^m}{\partial \Omega} = -\frac{a\beta^2(\theta^* - \bar{\theta}) - a\beta(y^* - \bar{y})}{(\bar{d} + \sigma_d^2)(\Omega(a\beta^2 + 1) - a\beta^2)^2} < 0$$

This relationship between Ω and δ^m captures the interaction between the model misspecification and the regulator's risk-sensitivity. A risk-sensitive regulator, with a high Ω, constrains "Nature" to select a smaller misspecification, v. The regulator's model is therefore more accurate, and the regulator's estimate of the leverage gap is closer to its true value. This leads to the less aggressive selection of δ^m.

Certainty Equivalence The macro-prudential policy rule of the baseline setting, (4.4), is the "certainty equivalent" rule where δ addresses the true value of the leverage gap without distortions. The slope of (4.4) with respect to the leverage gap is the best proportionate response for macro-prudential policy to address financial stability concerns. If the policy rule of the macro-pruential regulator deviates from this slope, then the regulator is not proportionately addressing the true *ex-ante* leverage gap.

The slope of the macro-prudential regulator's policy rule in the case of model uncertainty is given by:

$$\frac{\frac{\Omega}{\Omega-1}}{(\bar{d} + \sigma_d^2)(\frac{\Omega}{\Omega-1} + a\beta^2)}$$

The regulator will have certainty equivalence if this slope is equal to the slope of the unbiased policy rule, (4.3):

$$\frac{1}{1 + a\beta^2} = \frac{\frac{\Omega}{\Omega-1}}{(\bar{d} + \sigma_d^2)(\frac{\Omega}{\Omega-1} + a\beta^2)} \tag{4.11}$$

In the simplest case, when there is no instrument uncertainty and $\sigma_d^2 = 0$, model uncertainty will cause the the regulator to choose a more aggressive macro-prudential position than is necessary to address the true leverage gap. This is captured by $\frac{\Omega}{\Omega-1} > 1$, which over-weights the regulator's reaction to the leverage gap. The regulator's policy rule will improve if the over-weighting distortion is reduced, or as $\frac{\Omega}{\Omega-1} \to 1$, which occurs when the risk-sensitivity of the regulator, Ω, approaches infinity.[11] This is an intuitive result, as a highly risk-sensitive regulator has fewer model misspecifications, and therefore has a more accurate model of the economy. This regulator does not mistakenly over-react to the true size of the leverage gap, and $\delta^m \to \delta$.

In a more complex and realistic case, the macro-prudential regulator may be simultaneously subject to distortions from both model and instrument uncertainty. Instrument uncertainty causes the regulator to under-react to the leverage gap when selecting macro-prudential policy, while model uncertainty causes the regulator to over-react. As these distortions are in opposition to each other, the balance of these two forces determines whether the regulator would over- or under-react to the true leverage gap. It is even possible that the distortions caused by instrument and model uncertainty could cancel each other out entirely, leaving the regulator with an "unbiased" macro-prudential policy rule.

For the regulator to select an unbiased policy rule, the slope of the policy rule in the case of both instrument and model uncertainty, (4.10), must be equal to the slope of the unbiased rule, (4.3). This equality, (4.11), can be rearranged to find the level of risk-sensitivity and the level of instrument uncertainty that would generate equal positive and negative distortions to the regulator's policy rule which then perfectly cancel each other out:

$$\Omega_m^* = \frac{a\beta^2(\bar{d} + \sigma_d^2)}{(a\beta^2 + 1)(\bar{d} + \sigma_d^2 - 1)} \tag{4.12}$$

[11] There is a second case where the regulator's policy rule can be "undistorted" by model uncertainty: when the regulator has no secondary objective, i.e. the weighting on the output gap is $a = 0$. This regulator's policy rule is equivalent to the single-objective case for instrument uncertainty, $\delta^m = \frac{(\theta^* - \bar{\theta})}{(\bar{d} + \sigma_d^2)}$. However, this policy rule can still be distorted by *instrument* uncertainty, σ_d^2. This provides some justification for allowing a secondary macro-prudential objective ($a > 0$), as this can counteract the distortion caused by instrument uncertainty.

I define Ω_m^* as the "threshold" value of risk-sensitivity that leads to an exact balance between the over-reaction distortion of model uncertainty and the under-reaction distortion of instrument uncertainty. These distortions affect the regulator's policy rule in the opposite directions, which means that as σ_d^2 increases, the regulator's risk-sensitivity, Ω, must decrease:

$$\frac{\partial \Omega_m^*}{\partial \sigma_d^2} = -\frac{a\beta^2}{(a\beta^2+1)(\bar{d}+\sigma_d^2-1)^2} < 0$$

Failure to achieve the "threshold" value of risk-sensitivity is demonstrated in Figure 4.3. If a regulator's risk-sensitivity was already at the optimal level of e.g. $\Omega_m^* = 1.45$, and instrument uncertainty was to increase from $\sigma_d^2 = 0$ to $\sigma_d^2 = 0.2$, then the macro-prudential regulator would have a more pronounced incentive to under-react to the leverage gap. This causes the regulator's reaction curve to swivel *below* the unbiased certainty response curve. A contrasting case is also shown in Figure 4.3 when risk-sensitivity decreases (from $\Omega_m = 2$ to $\Omega_m = 1.01$), which is below the "threshold" value of $\Omega_m^* = 1.45$. This case causes the regulator's policy rule to become overbalanced in favour of *over*-reacting to the leverage gap.

4.2.4 Leaning Against the Wind

The focus of this chapter is to question whether allowing a central bank to lean against the wind would improve or worsen the macro-prudential regulator's policy rule with respect to its *ex-ante* financial stability objective.

I follow Smets (2014) in incorporating leaning against the wind as a second objective of financial stability in the monetary authority's objective function. The inclusion of instrument and model uncertainty means that the sequence of events in this model is now (1) the malevolent representative player "Nature" maximises loss to the macro-prudential regulator by selecting a model misspecification term; (2) the macro-prudential regulator minimises loss over leverage and output deviations, and; (3) the central bank minimises loss over price and leverage deviations.

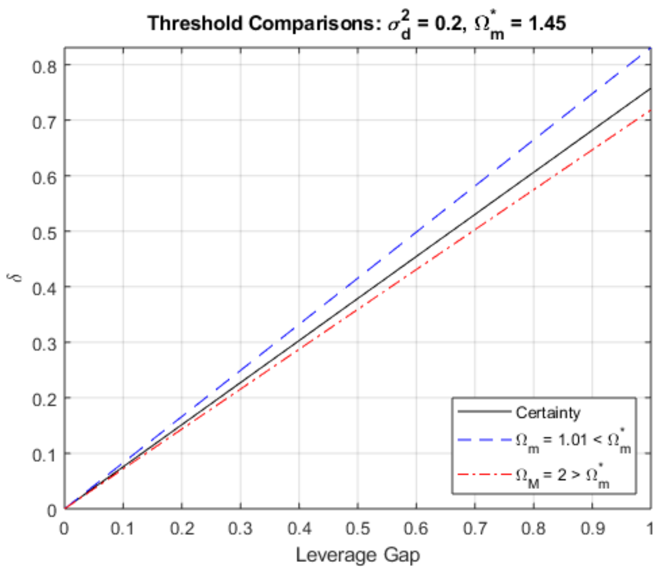


Figure 4.3: High risk-sensitivity ($\Omega_m > \Omega_m^*$) leads to an under-reactive policy rule. Low risk-sensitivity ($\Omega_m < \Omega_m^*$) leads to an over-reactive policy rule.

Formally, the macro-prudential regulator selects their policy to minimise loss over their unchanged loss function, (L^M):

$$L^M = \frac{1}{2}(\theta^* - \theta)^2 + \frac{a}{2}(y^* - y)^2$$

The central bank subsequently minimises their new loss function, (L^{LAW}), over both leverage and price objectives:

$$L^{LAW} = \frac{1}{2}(\pi^* - \pi)^2 + \frac{b}{2}(\theta^* - \theta)^2$$

The central bank's weighting of the leverage gap, b, captures the extent to which the central bank is "leaning against the wind". In previous sections of this chapter, this weighting was equivalent to $b = 0$, demonstrating no consideration by the monetary authority for the financial objective. An institutional arrangement where $b > 0$ may not necessarily reflect an explicit financial mandate. For example, the relevant legislation directing the Reserve Bank of Australia (RBA) requires that monetary policy be executed "with regard to" the stability of the financial system, suggesting that b may be greater than zero (if only marginally).

In the first stage of this model, "Nature" predetermines the extent of model misspecification, v, to maximise loss over the financial objective, L^N, subject to the leverage condition for instrument and model uncertainty, (4.8):

$$L^N = \frac{1}{2}(\theta^* - \theta)^2 - \frac{\Omega}{2}v^2$$

This yields the loss maximising model misspecification, now denoted v^{LAW} to reflect the model of leaning against the wind:

$$v^{LAW} = \frac{(\bar{d} + \sigma_d^2)\delta^{LAW} - (\theta^* - \bar{\theta}) - (\pi^{LAW} - \pi^e)}{\Omega - 1}$$

The macro-prudential regulator then minimises loss, L^M. However, the central bank's subsequent policy choice will now also address a portion of the financial objective. The macro-prudential regulator can anticipate this portion that the central bank will address by considering the central bank's reaction function. This is given by the minimisation of the central bank's loss function, L^{CB}, subject to leverage, (4.8):

$$\pi^{LAW} = \pi^* - b(\theta^* - \bar{\theta}) - b(\pi^{LAW} - \pi^e) + b((\bar{d} + \sigma_d^2)\delta^{LAW} + v) \tag{4.13}$$

With this in hand, the macro-prudential authority minimises L^M in the second stage of the model (following "Nature") subject to output (4.2), leverage (4.8), and the monetary authority's reaction function, (4.13). This yields optimal macro-prudential policy, evaluated at its expected value and under the assumption of rational expectations:

$$\delta^{LAW} = \frac{(\theta^* - \bar{\theta}) + \frac{a(\alpha b + \beta)}{1-b}(y^* - \bar{y}) - v}{(\bar{d} - \sigma_d^2)(1 + \frac{a\beta(\alpha b + \beta)}{1-b})}$$

The central bank then satisfies the third and final stage of the model by selecting monetary policy according to their reaction function.

The equilibrium solutions for the model misspecification, v, and the macro-prudential policy rule, δ^{LAW}, are given by:

$$v^{LAW} = -\frac{\frac{a\beta(\alpha b+\beta)}{1-b}(\theta^* - \bar{\theta}) - \frac{a(\alpha b+\beta)}{1-b}(\bar{d}+\sigma_d^2)(y^* - \bar{y})}{(\bar{d}+\sigma_d^2)\Omega + \frac{a\beta(\alpha b+\beta)}{1-b}(\Omega - 1)} \tag{4.14}$$

$$\delta^{LAW} = \frac{(\frac{\Omega}{\Omega-1})(\theta^* - \bar{\theta}) + \frac{a(\alpha b+\beta)}{1-b}(y^* - \bar{y})}{(\bar{d}+\sigma_d^2)(\frac{\Omega}{\Omega-1} + \frac{a\beta(\alpha b+\beta)}{1-b})} \tag{4.15}$$

The key insight of policy rule (4.15) is that leaning against the wind by the central bank ($b > 0$) causes the macro-prudential regulator to increase their weighting of the output gap from $a\beta$ to $\frac{a(\alpha b+\beta)}{1-b}$. This is because the regulator knows that a portion of the financial objective will be resolved using "costless" (to the regulator) monetary policy, leaving the regulator to focus on their secondary objective. Formally,

$$\frac{\partial \delta^{LAW}}{\partial b} = -\frac{\frac{a\beta(\alpha+\beta)}{1-b}(\theta^* - \bar{\theta}) + \frac{a(\alpha+\beta)}{1-b}(y^* - \bar{y})}{(\bar{d}+\sigma_d^2)\left(1 + \left(\frac{a\beta(\alpha b+\beta)}{1-b}\right)^2\right)} < 0$$

As the regulator shifts their focus towards the output objective, their relative weighting of the financial objective decreases in comparison to the case without leaning against the wind. Leaning against the wind therefore gives the macro-prudential regulator an incentive to under-react to the leverage gap. Importantly, if $b = 0$ and the monetary authority does not lean against the wind, the weighting of the output objective returns to $a\beta$, and policy rule (4.15) is equivalent to previous sections.

Certainty Equivalence The best practice macro-prudential policy rule addresses the true *ex-ante* financial stability objective, which is given in the certainty baseline case in the regulator's policy rule, (4.3). If the slope of the regulator's policy rule, (4.15), is equal to the slope of (4.3), then the macro-prudential regulator will respond proportionately to the *ex-ante* leverage gap as if their policy rule had not been distorted by any biases. This condition is given by:

$$\frac{1}{1+a\beta^2} = \frac{\frac{\Omega}{\Omega-1}}{(\bar{d}+\sigma_d^2)\left(\frac{\Omega}{\Omega-1} + \frac{a\beta(\alpha b+\beta)}{1-b}\right)}$$

In a simple case without distortions from uncertainty (i.e. instrument uncertainty $\sigma_d^2 = 0$ and risk-sensitivity $\Omega \to \infty$ such that the model misspecification $v \to 0$), the regulator would only achieve certainty equivalence if $b = 0$ and the central bank does not lean against the wind. This is because any $b > 0$ would cause the regulator to under-react to the full value of the leverage gap, and instead focus on their secondary (output stability) objective. This is the result found by Smets (2014), and is the primary conclusion by which Smets (as well as Ueda and Valencia, 2014) considers leaning against the wind to be undesirable.

This result changes with the introduction of distortions from model and instrument uncertainty. If the over-reaction distortion from model uncertainty is larger than the under-reaction distortion from instrumental uncertainty, then the regulator is *overreacting* to the true *ex-ante* leverage gap. If the central bank then chose to lean against the wind would, this would improve the regulator's policy rule because it incentivises the regulator to weaken their macro-prudential policy rule and swivel closer to the preferred certainty equivalent rule. This benefit of leaning against the wind is shown in Figure 4.4.

In contrast, if the net distortion due to policy uncertainty causes the macro-prudential regulator to *under-respond* to the leverage gap, then leaning against the wind would worsen the macro-prudential policy rule as it is pushed *further* from the certainty equivalent case. This is demonstrated in Figure 4.5, where the distance between the risk-sensitivity of the regulator and certainty equivalence increases as b increases.

Model uncertainty — which is driven by the regulator's degree of risk-sensitivity — distorts the macro-prudential regulator's policy rule in the opposite direction to the distortions caused by instrument uncertainty and by leaning against the wind. This means that there is an optimal or "threshold" level of risk-sensitivity that creates an over-reaction distortion to cancel out the under-reaction distortions of instrument uncertainty and leaning against the wind.

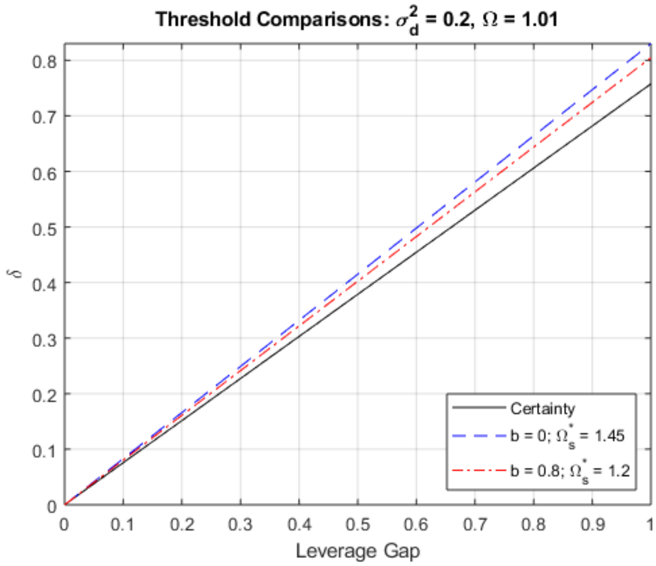


Figure 4.4: High model misspecifications v arising from low risk-sensitivity Ω leads to aggressive macro-prudential policy. Leaning against the wind ($b > 0$) reduces the leverage deficit.

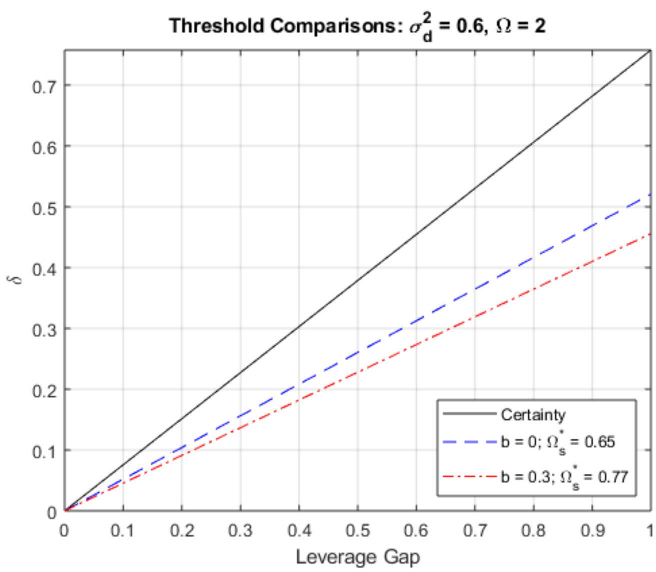


Figure 4.5: High instrument uncertainty σ_d^2 leads to cautious macro-prudential policy. Leaning against the wind ($b > 0$) worsens the leverage deficit.

This threshold value of risk-sensitivity, Ω^*_{LAW}, is now given by:

$$\Omega^*_{LAW} = \frac{\frac{a\beta(\alpha b+\beta)}{1-b}(\bar{d}+\sigma_d^2)}{(\frac{a\beta(\alpha b+\beta)}{1-b}+1)(\bar{d}+\sigma_d^2)-(a\beta^2+1)}$$

The threshold value of the regulator's risk-sensitivity, Ω^*_{LAW}, is smaller than the threshold value of risk-sensitivity estimated in the previous section, Ω^*_m. This is because the macro-prudential regulator needs an additional incentive to over-react to cancel out the additional incentive to under-react caused by leaning against the wind. The macro-prudential regulator can do this if they have a lower level of risk-sensitivity, Ω^*_{LAW}, as this allows "Nature" to select a larger model misspecification to encourage over-active macro-prudential policy.

As the monetary authority's concern for the financial stability objective increases, the size of the regulator's risk-sensitivity, Ω^*_{LAW}, must also decrease, allowing for further model misspecifications and a stronger over-reaction incentive, to maintain certainty equivalence (formally, $\frac{\partial\Omega^*_{LAW}}{\partial b} < 0$).

4.3 Policy Implications

Existing commentary on the viability of a financial stability objective within the central bank has suggested either that leaning against the wind is appropriate and necessary due to an inherent flaw in macro-prudential policy (Stein, 2013; Adrian and Liang, 2014), or that leaning against the wind is inappropraite due to the distraction it places on the macro-prudential regulator (Ueda and Valencia, 2014; Smets, 2014). These authors, however, do not consider the role that leaning against the wind can have in improving a flawed *ex-ante* macro-prudential policy rule.

My analysis demonstrates that leaning against the wind can be appropriate if instrument and model uncertainty in macro-prudential policy would have caused the regulator to over-react to prevailing financial conditions. Table 4.2 summarises this result.

	High Model Uncertainty (High v, low Ω)	Low Model Uncertainty (Low v, high Ω)
High Instrument Uncertainty (High σ_d^2)	Strict separation of objectives: $b = 0$	Strict separation of objectives: $b = 0$
Low Instrument Uncertainty (Low σ_d^2)	Leaning against the wind: $b > 0$	Strict separation of objectives: $b = 0$

Table 4.2: Leaning against the wind, $b > 0$, is preferred if there is low instrument uncertainty and high model uncertainty over macro-prudential policy, but *not* in any other case.

I find that leaning against the wind is an appropriate and preferred policy approach for the central banker when macro-prudential policy has a low level of instrument uncertainty, σ_d^2, and a high level of model uncertainty, which is inversely proportional to the risk-sensitivity of the regulator, Ω.[12] In any other combination of instrument or model uncertainty, the macro-prudential regulator would be under-reacting to financial conditions before the intervention of the central bank. Leaning against the wind would only encourage the regulator to further "ease" their policy rule, which means that a central bank who adopts financial stability as an objective will compromise *ex-ante* financial stability in the macro-prudential regulator.

The instrument uncertainty or "volatility" of macro-prudential instruments tends to be higher in countries with large, heterogeneous financial markets (Cerutti et al., 2016; Altunbas et al., 2017), complex regulatory frameworks (Lim, 2011; Herring, 2018), and also during downturns in the financial cycle (Claessens et al., 2013; Kuttner and Sim, 2013; McDonald, 2015; Cerutti et al., 2017; Altubas et

[12] More explicitly, leaning against the wind is not preferred if the regulator's risk-sensitivity is high, or above the "threshold" value (i.e. $\Omega > \Omega^*_{LAW}$). This will be the case if a high level of instrument uncertainty pushes the threshold value of Ω^*_{LAW} below 1, as this level of risk-sensitivity is strictly unattainable for the regulator. The level of instrument uncertainty that corresponds to $\Omega^*_{LAW} < 1$ is $\sigma_d^2 > a\beta^2 + 1 - \bar{d}$.

al., 2017). This implies that a central bank would only adopt a financial stability objective without compromising *ex-ante* financial stability in the macro-prudential regulator, if they were in a small or highly concentrated financial market with simple, rule-based regulations, during periods of financial expansion.

Further, the uncertainty driven by misspecifications to a macro-prudential model is inversely proportional to the regulator's risk-sensitivity, which suggests that a central bank should only lean against the wind if the regulator has a low level of risk-sensitivity (or, has a misspecified model). Although there is limited research in this area, BCBS (2013) suggests that the risk-sensitivity of regulators can increase if macro-prudential policy is housed within the same authority as monetary policy (e.g. the Reserve Bank of New Zealand), as this increases the resourcing and capabilities of the regulator with regard to macro-prudential modelling. This implies that a central bank should not adopt a secondary financial stability objective for monetary policy if it is also home to macro-prudential decision makers.

4.4 Conclusion

Following the global financial crisis and the heightened importance of financial stability in broader economic outcomes, there has been broad discussion on whether central banks should lean against the wind and address financial stability concerns using monetary policy tools.

In this chapter, I explore a specific aspect of this discussion to shed light on whether leaning against the wind would improve or worsen the ability of a distorted macro-prudential regulator to achieve *ex-ante* financial stability. In doing so, I address one of the key arguments in support of leaning against the wind, which is that ineffective macro-prudential policy requires the assistance of monetary policy, and also address one of the key arguments in opposition to leaning against the wind, which is that monetary policy can have a distorting effect on the macro-prudential regulator.

I find that leaning against the wind is the preferred policy role for a central bank if the macro-prudential instrument is not very volatile, and if the macro-prudential regulator has a low level of risk-sensitivity or low accuracy of their macro-prudential models. This is because the combination of an instrument with low uncertainty and a model with low accuracy, leads the macro-prudential regulator to over-react to changes in the financial climate. Leaning against the wind by a central bank will detract the regulator's focus from its financial objective, and inadvertently improve the regulator's *ex-ante* provision of financial stability.

Although such a simple model captures only a snapshot of what is ultimately a complex and ever-evolving issue, it offers some insights into the suitability of leaning against the wind under different conditions of macro-prudential policymaking. First, leaning against the wind may not be practicable in large, complex financial systems with diverse institutions. Second, leaning against the wind would not improve *ex-ante* financial stability during financial downturns, as this would weaken the macro-prudential response. And third, leaning against the wind may not be necessary if both monetary policy and macro-prudential policy are conducted under the umbrella of the same institution, as has been the practice for many central banks in the decade following the global financial crisis.

Chapter 5

Summing Up

In this thesis, I have explored the past, present, and future of New Zealand's financial stability through the estimation of New Zealand's medium-term financial cycle; a close examination of New Zealand's 1984 currency crisis; and a theoretical consideration of the interaction of monetary policy and macro-prudential policy in pursuit of financial stability outcomes. My results suggest that the nature of the New Zealand financial cycle changed fundamentally after the liberalising reforms of the mid-1980s, leading to greater synchronisation with international capital markets; that the 1984 currency crisis was the result of self-fulfilling market expectations, coordinated by the announcement of a snap election; and that using monetary policy to address financial stability is appropriate if the macro-prudential regulator has a low level of risk-sensitivity, and if the macro-prudential instrument is well-tested and known to be effective over the financial stability objective.

My estimates of of New Zealand's financial cycle in Chapter 2 suggest that with the changing nature of the cycle after the reforms of the mid-1980s, domestic policymakers in search of financial stability would do well to consider the role of international capital markets when setting New Zealand macro-prudential policy. This is particularly relevant for the coordination of macro-prudential policy between nations, as the the outcomes and policy responses of contemporary economies could shape New Zealand's financial conditions. The coincidence of financial cycle contractions and real economic recessions highlights the importance of understanding the financial cycle, as Drehmann et al. (2012) emphasise in their influential work on financial and real economic downturns.

My exploration of New Zealand's 1984 currency crisis in Chapter 3 affords some insights to the importance of political economy and political institutions in the pursuit of financial stability outcomes, especially in markets where speculator expectations can influence future outcomes. The role of information in forming expectations implies that New Zealand policymakers should take care when coordinating or aligning policy decisions with the decisions of contemporary economies (such as Australia), as this may drive expectations of a policy change in New Zealand despite a lack of signalling by New Zealand policymakers. Rother (2009) notes that a country that has more frequent elections may see a higher frequency of financial or other political crises, due to the coordinating effect of elections in driving speculator expectations. New Zealand, with one of the shortest executive term lengths in the world, may therefore expect to see more turbulent markets and outcomes when the outcomes are tied to expectations and forward offerings of market participants.

Finally, the results of the theoretical model outlined in Chapter 4 suggest that leaning against the wind is not preferred if a country has a high level of uncertainty around the efficacy of the macro-prudential instrument, or if the risk-sensitivity of the macro-prudential regulator is very high. This result emerges because leaning against the wind relaxes the *ex-ante* macro-prudential response, which is exacerbated by uncertainty around macro-prudential efficacy, and attenuated by high levels of model uncertainty — such as would be seen with a regulator with weak risk-sensitivity. These results further suggest that monetary policy should not be used to address financial stability during financial downturns, as the efficacy of macro-prudential instruments is generally lower during this phase of the financial cycle.

These insights over the nature of financial stability in New Zealand have some relevance for the ongoing review of the RBNZ Act, which is seeking to enhance the framework for macro-prudential and other financial stability policies in New Zealand.

The insights of Chapter 4 are the most relevant for the the ongoing Review of the RBNZ Act, as the extent of instrument and model uncertainty in New Zealand's macro-prudential policymaking can inform the appropriateness of leaning against the wind and using monetary policy to support financial stability objectives. An argument could be made that New Zealand possesses a low level of macro-prudential instrument uncertainty, due to the concentration of financial activity within a small number of players and a relatively homogeneous response to macro-prudential instruments (Bollard, Hunt, and Hodgetts, 2011). The low number of macro-prudential instruments implemented by the RBNZ (with eight active measures, compared to the international average of 9.3; IMF, 2018) also suggests that New Zealand's regulatory framework is not excessively complicated.

The Review of the RBNZ Act signals a high degree of risk-sensitivity by the RBNZ over New Zealand's macro-prudential framework. The nesting of macro-prudential concerns within the RBNZ also suggests a high level of resourcing and capability, due to the potential for combined and experienced analytical teams, and the potential for information sharing. This, on balance, suggests that leaning against the wind may not be preferred for New Zealand, and that monetary policy should not lean against the wind to address financial stability concerns, due to the low level of model uncertainty in New Zealand's relevant macro-prudential regulator.[1]

[1] Concerning the role of monetary policy during times of crisis — such as the sharp economic and financial contraction that has recently emerged following the COVID-19 global pandemic

Beyond these institutional comments, the insights of Chapter 2 suggest that the New Zealand financial cycle had begun to contract from late-2014, which corresponds with the introduction of macro-prudential measures by the RBNZ. The contraction of medium-term financial activity in New Zealand at this time hints at the success of macro-prudential measures in reigning the expansion of financial appetites, although the ongoing contraction suggests that it may have been appropriate to ease these measures in later years.

The insights of Chapter 3, on the nature of New Zealand's political economy and the advent of financial crises, have limited relevance to the ongoing RBNZ Review on account of the institutional independence of the RBNZ from the executive branch of New Zealand government, although New Zealand's shorter election term could provide "spillovers" for the RBNZ to consider in its macro-financial policy due to potential instability in proximity to elections.

The limitations of my research largely reflect the common weaknesses inherent in this type of empirical, historical, and theoretical research. My estimation of New Zealand's financial cycle, for example, is a retrospective exercise that does little to suggest the appropriate current or future settings for macro-prudential policy. Similarly, my historical consideration of New Zealand's 1984 currency crisis has limited relevance to the floating exchange rate that New Zealand enjoys today. The analytical model explored in Chapter 4 is a simplification of markets that are much more complex in reality, particularly when one considers the increased role of international capital markets on small open economies such as New Zealand that are unaccounted for in the model altogether.

Future work in this area could therefore include a more timely financial cycle or dashboard of financial indicators to support immediate or short-term macro-prudential policy settings; a broader consideration of New Zealand's financial crises,

— this analysis suggests that leaning against the wind is not the preferred option for *ex-ante* financial stability if there is a high level of uncertainty around the efficacy of the macro-prudential instrument, as is generally the case during sharp downturns.

to identify common trends and extrapolate relevant lessons for New Zealand's current economic climate. Finally, a more complex model of macro-prudential and monetary policy, possibly with consideration for international coordination, or with consideration for the efficacy of monetary policy as well as the efficacy of macro-prudential policy in pursuit of financial stability outcomes.

Appendices

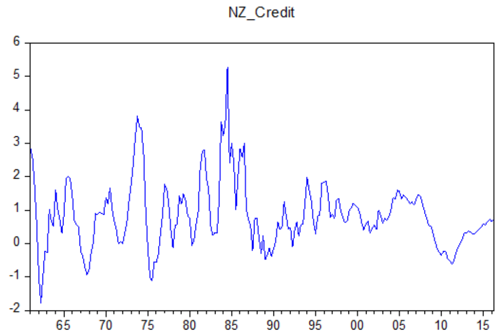
Appendix A

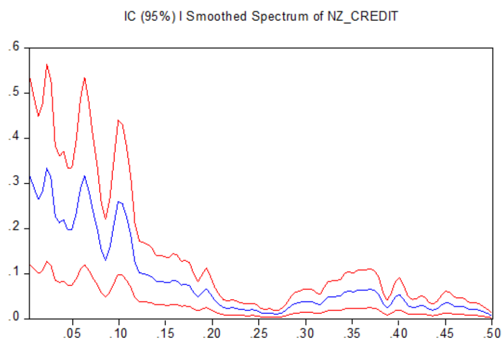
New Zealand Financial Cycle Data

The data stretches from 1960 Q1 to 2017 Q1 and nominal variables have been normalised by the CPI. All variables are calculated in yearly percentage changes normalised by standard deviation, with the exception of the interest rate spread, which is calculated as a yearly difference normalised by standard deviation, due to extreme outliers.

The financial conditions index is based on the following nine variables: credit, credit/GDP, M3, M3/GDP, credit/broad money, house prices, stock prices, interest rate spread, gross capital formation of housing/GDP. These variables are commonly used in financial cycle estimation and are briefly described below, along with the associated spectral analysis graphs.

The x-axis of the spectral analysis graphs depicts the length of a potential cycle that can be found within the data, where the left-hand side of the axis depicts longer cycle durations. (Specifically: an x-axis value of 0.05 is equal to $1/0.05 =$ 20 quarters = 5 years.) The y-axis of the spectral analysis graphs measures the "frequency", or how common a cycle of that length is within the data. The blue line

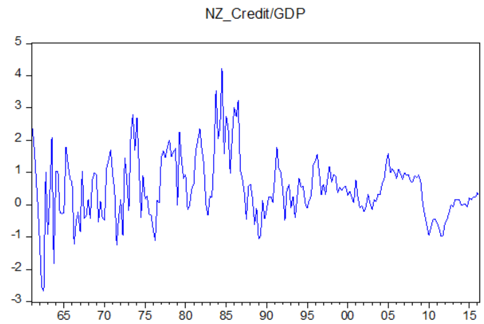


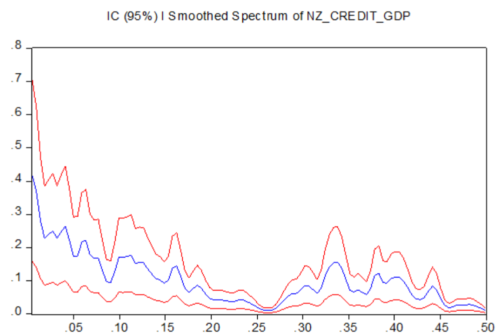


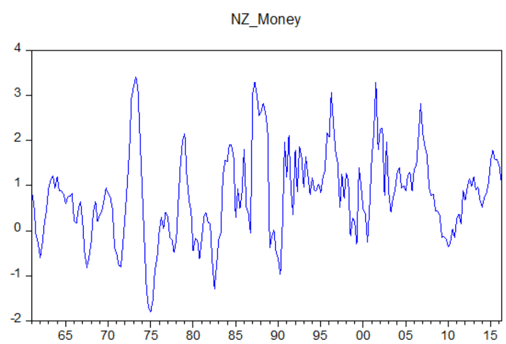
reflects the commonality of a certain cycle length and the red bands correspond to the 95% confidence interval.

Credit and credit/GDP. Credit is interpreted as credit to all non-financial sectors and, along with credit/GDP. The spectral analysis of the credit variable suggests a number of cycles that are two, four, and ten years in length, while spectral analysis of the credit/GDP variable suggests a high number of cycles that have a length of three or more years.

Broad money (M3), M3/GDP. We follow Einarsson et al. (2016) and include M3 in our financial cycle estimation. Broad money enables the effective reserve ratio of banks to be considered, thereby capturing the liquidity of banks and the demand for monetary assets in the economy. There is a gap in 1977, which we fill using the average of each corresponding quarter from 1976 and 1978. Spectral

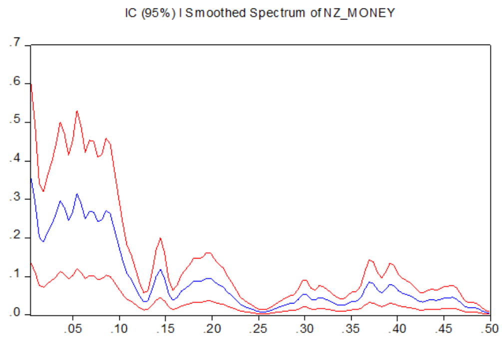






analysis suggests a large number of cycles that are two or more years in length. Spectral analysis of money suggests a high number of cycles greater than two years in length, while spectral analysis of M3/GDP suggests a high number of cycles that are two years or four years in length.

Credit/M3. This ratio measures the extent to which increases in broad money supply may be due to increased non-financial credit and, hence, the extent to which non-financial risk taking exceeds financial sector risk-taking. There are a number


IC (95%) I Smoothed Spectrum of NZ_MONEY
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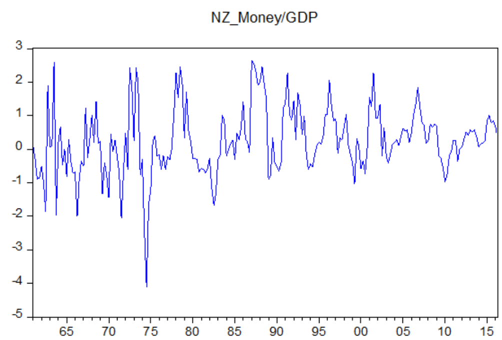
NZ_Money/GDP
3
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-5
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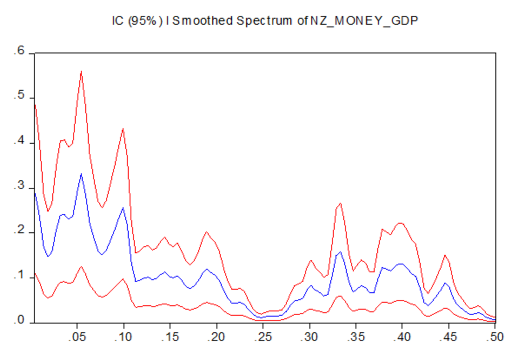
IC (95%) I Smoothed Spectrum of NZ_MONEY_GDP
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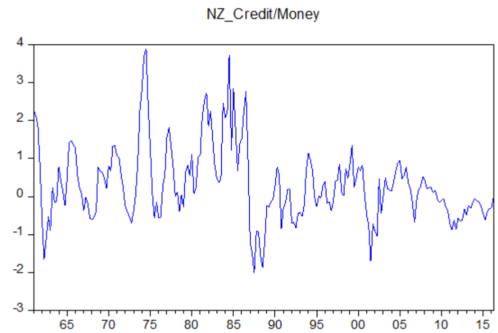
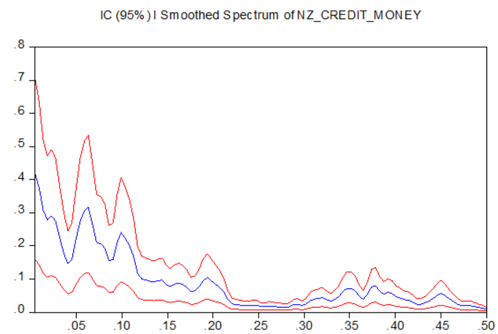
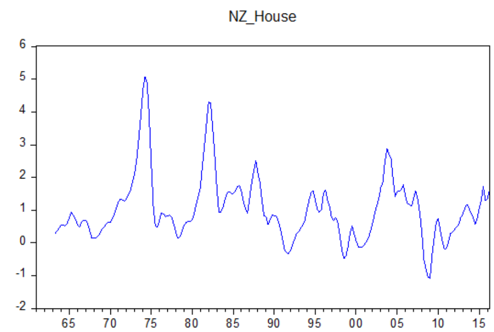




of frequent cycle lengths within the time series, lasting either two, four, or over ten years.

House price index and Gross capital formation of housing/GDP. House price indices are typically used in the financial cycle literature to capture asset price inflation. Raw house price data in New Zealand is fairly limited and we draw on available data from the RBNZ website (1962 Q2 – 2017 Q1). House price cycles have a common length of four or ten years. Gross capital formation of housing/GDP serves as a proxy for a house price/GDP ratio. The ratio calculates how much capital spending has been invested in housing creation relative to income. To the extent that it captures risky behaviour, an increase in the ratio might imply a degree of speculation in future property values. The common cycle length of gross capital formation in housing-to-GDP is ten years, in addition to white noise representing cycles of less than a year in length.


NZ_House
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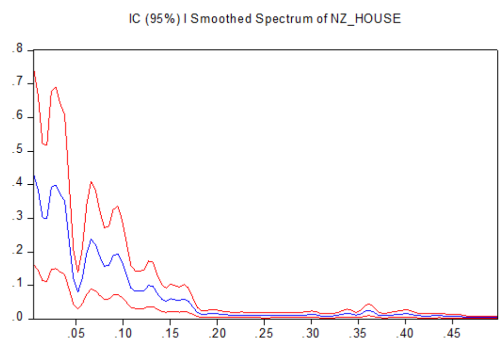
IC (95%) I Smoothed Spectrum of NZ_HOUSE
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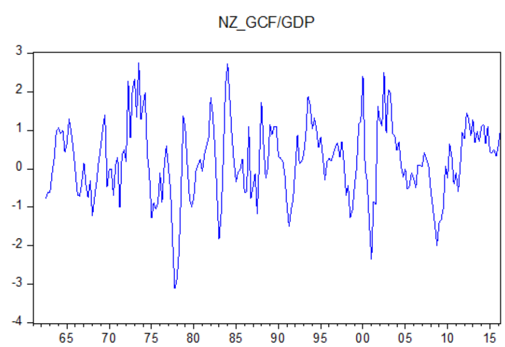
NZ_GCF/GDP
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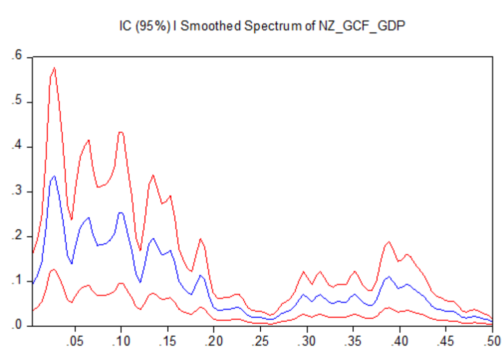
IC (95%) I Smoothed Spectrum of NZ_GCF_GDP
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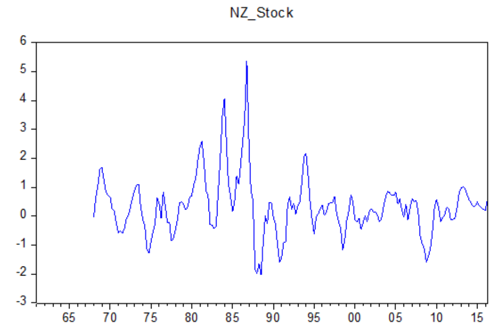
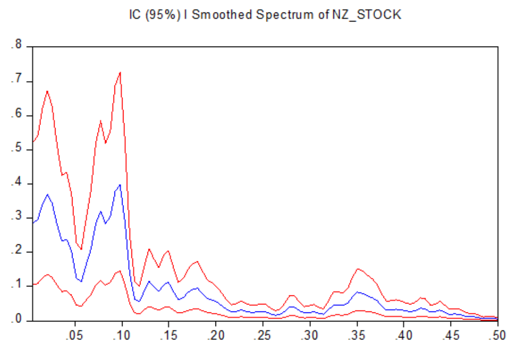
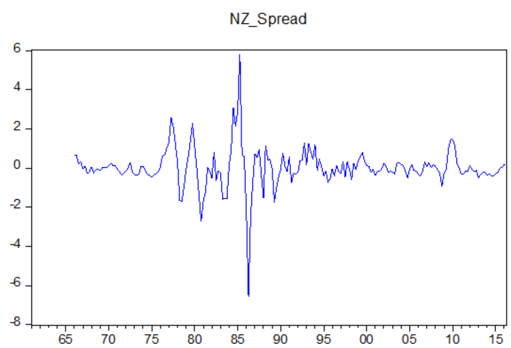
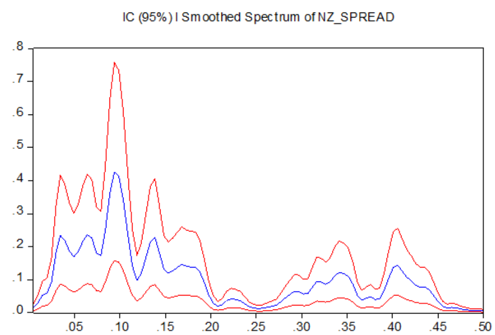






Stock price index, interest rate spread. Stock prices are another common variable used in financial cycle estimation. We use the NZSE share price index and find common cycle lengths of around two-three years and ten years in length. The interest rate spread represents the profit margin of banking institutions as measured by the difference in first mortgage rates and six-month deposit rates. There are many cycles with a length of two-to-five years, although it is difficult to make strong distinctions between short-term and medium-term cycles in this case.


IC (95%) l Smoothed Spectrum of NZ_SPREAD
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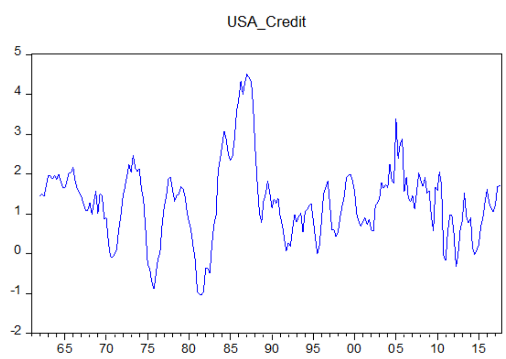
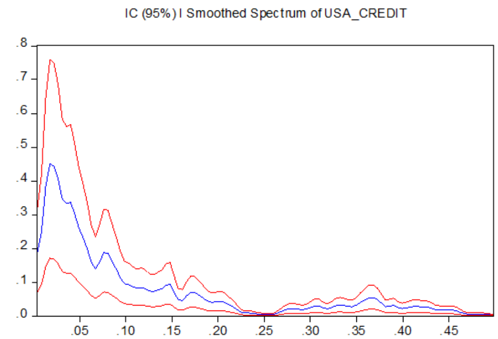
Appendix B

US Financial Cycle Data

All variables are sourced from Datastream and calculated in yearly percentage changes normalised by standard deviation. Nominal variables have been normalised by CPI. The charts below graph these data and reports the associated spectral analysis for each variable.

Credit and credit/GDP. Credit is interpreted as credit to all non-financial sectors. The spectral analysis of the credit variable suggests a number of cycles that are twelve years in length. There are many cycles with a length of three and a half years, and twelve or more years for the credit/GDP ratio.




IC (95%) I Smoothed Spectrum of USA_CREDIT
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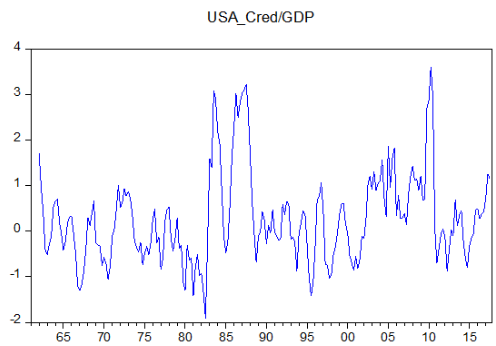
USA_Cred/GDP
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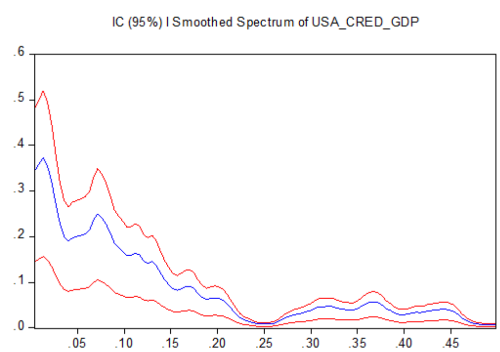
IC (95%) I Smoothed Spectrum of USA_CRED_GDP
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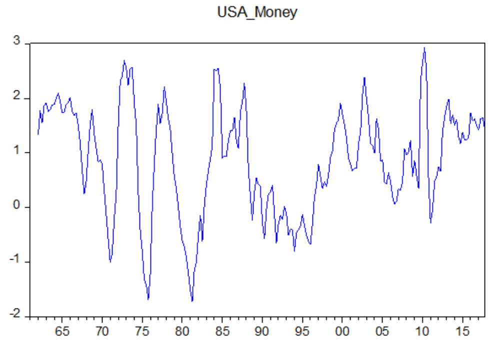
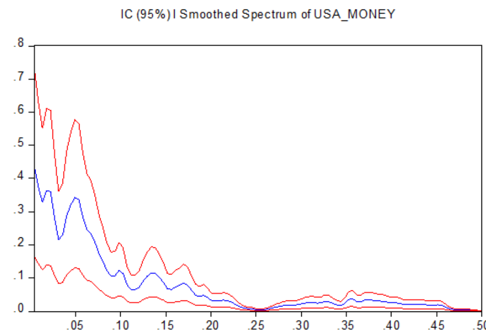
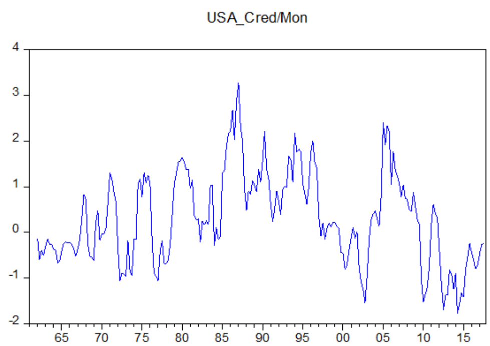
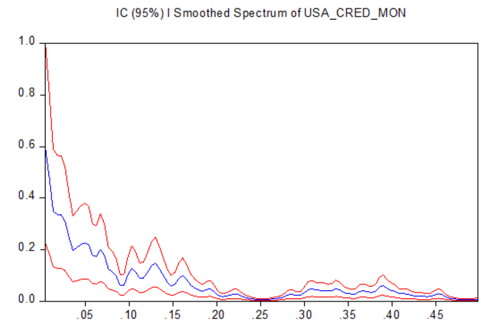


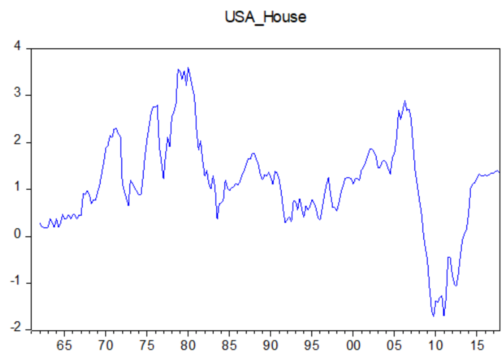


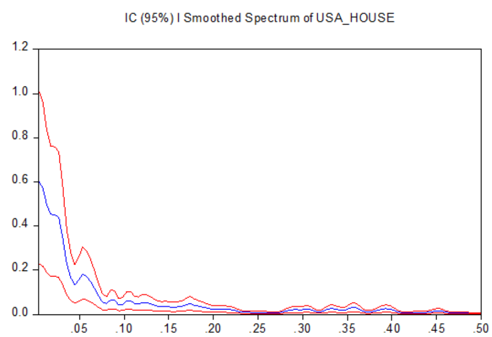


Broad money (M3), Credit/Money. The discontinuation of M3 in 2006 means that, in contrast to the New Zealand data, we rely on M2 to capture broad money in the US. Spectral analysis of broad money suggests a high number of cycles that are three or more years in length. Spectral analysis of credit/money also suggests a high number of cycles greater than three years in length.

House price index and Gross capital formation of housing/GDP. Spectral analysis on the US house price index reveals that house price cycles have a

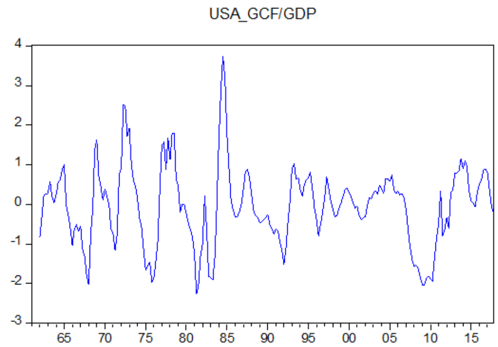






common length of six or more years. The most common cycle length of the gross capital formation in housing-to-GDP ratio is four or more years, with a small number of cycles between one and four years in length.

Stock price index. The US stock price index is measured by the NYSE composite index. Spectral analysis on this variable reveals many cycle lengths of one and a half years or longer.


USA_GCF/GDP
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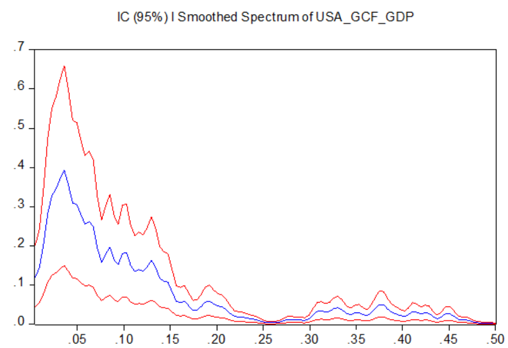
IC (95%) I Smoothed Spectrum of USA_GCF_GDP
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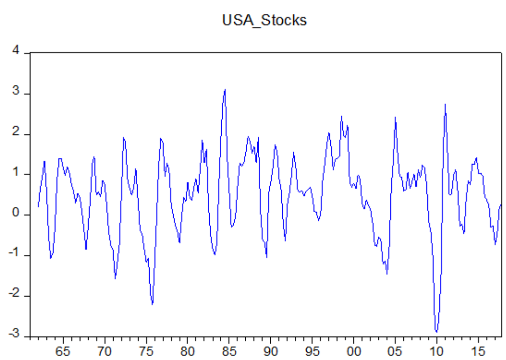
USA_Stocks
4
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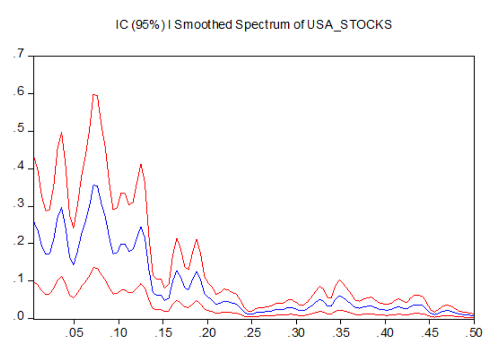
65 70 75 80 85 90 95 00 05 10 15


IC (95%) I Smoothed Spectrum of USA_STOCKS
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.05 .10 .15 .20 .25 .30 .35 .40 .45 .50

Appendix C

Financial Cycle Data Sources

Variable Name	NZ Datastream ID(s)	US Datastream ID(s)
Real GDP	NZOCFFDDD	USGDP...D
Credit	NZBLCAPAA	USBLCACCA
Broad Money	RBNZ Website	USQ59MBCB
Gross Capital Formation	NZOCFIHSD	USOCFIHSD
House Price Index	RBNZ Website	USHPI...F
Stock Price Index	NZQSP001F	USQSP001F
Interest Rate Spread	NZQIR08OR and NZ6MDEPR	Not calculated

Appendix D

Key Graphs for New Zealand 1954-1985

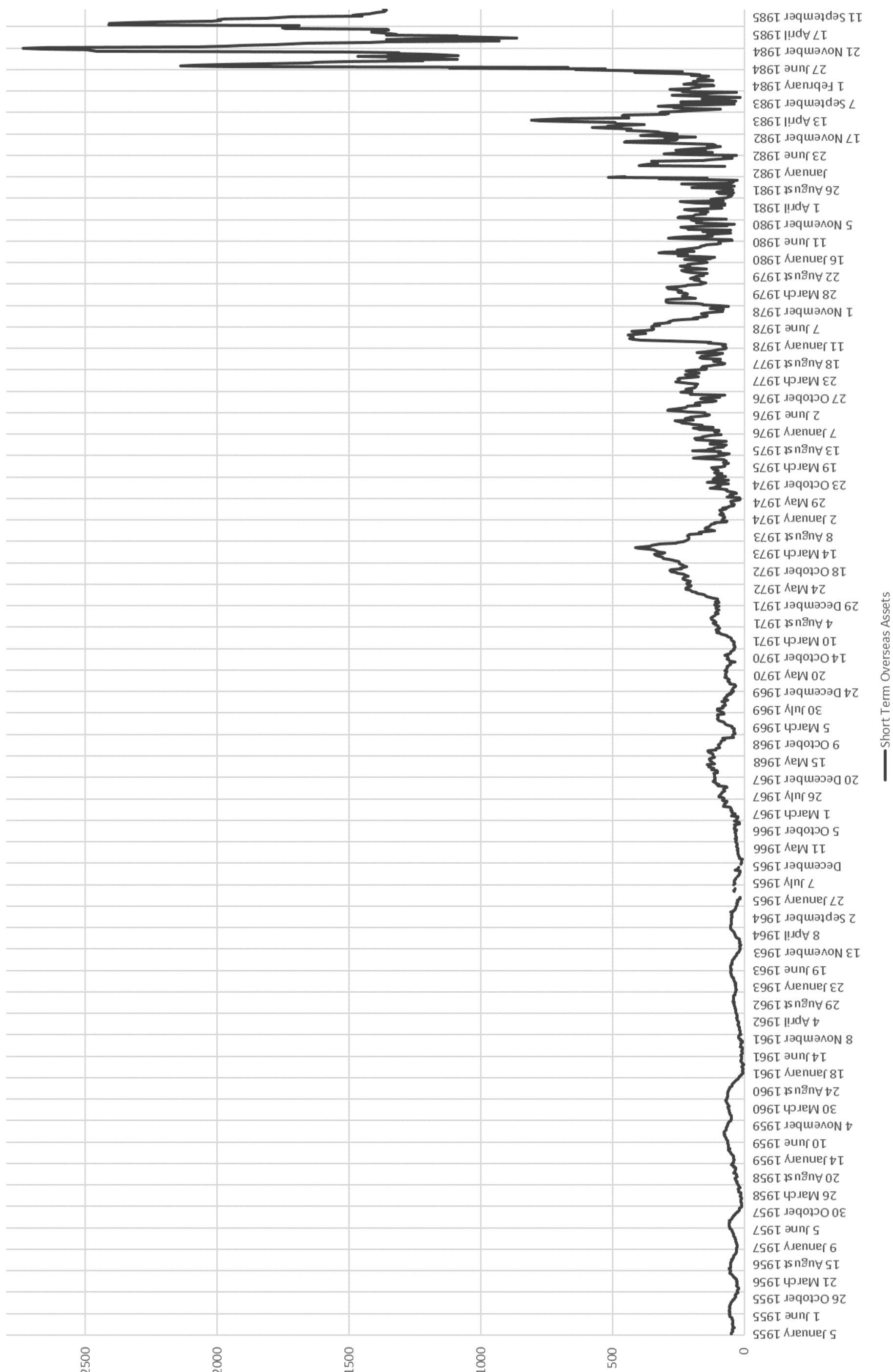
This appendix contains key data for the New Zealand economy between 1954 and 1985. The majority of these graphs contain hand-collected data from RBNZ monthly bulletins, unless otherwise credited, and are monthly, unless otherwise stated. The following data is included in this appendix:

- RBNZ Weekly Short Term Overseas Assets: 1954-1985
- RBNZ Weekly Liabilities: 1954-1985
- RBNZ Weekly Core Assets-to-Liabilities Ratio: 1955-1985
- Average Mortgage and Government Yields: 1954-1985
- Annual Public Debt: 1941-1985
- International Government Yields: 1954-1985
- Exports, Imports, and Trade Balance: 1954-1985
- Balance of Payments: 1954-1985

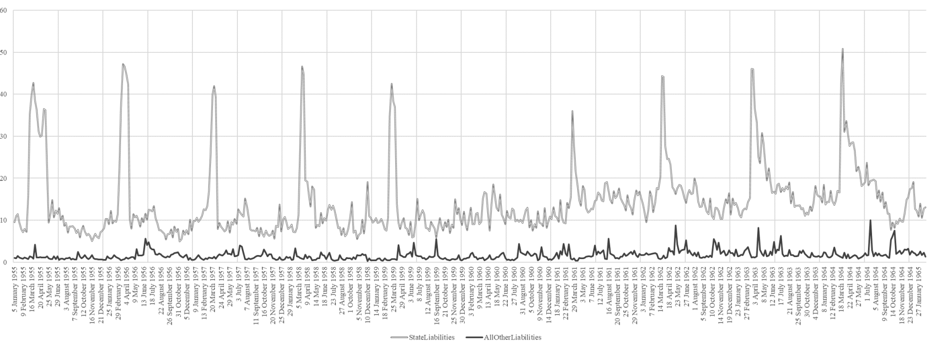
- Current Account and Invisibles Balance: 1961-1985
- Number of Unemployed: 1957-1985
- Trading Bank Lending as Portion of Lending Limits: 1961-1985
- Changes in Trading Deposits: 1955-1985

Note that the New Zealand pound was replaced by the New Zealand dollar on 10^{th} July 1967. Accordingly, if the indicator is denominated in nominal dollars or pounds, the graphs have been broken into New Zealand pounds pre-January 1967, and New Zealand dollars post-January 1967.

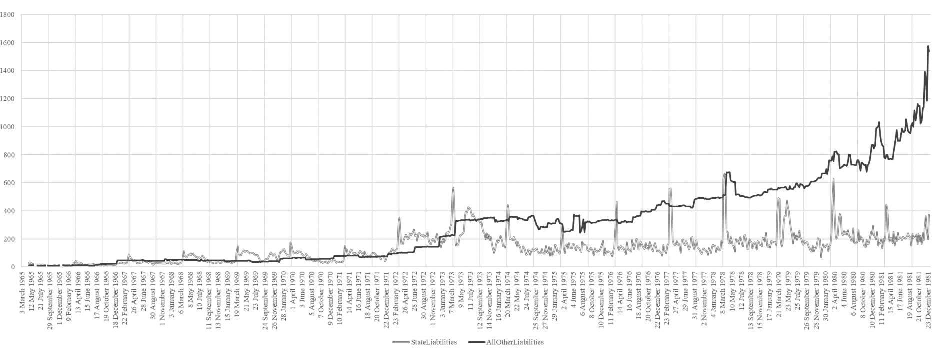
RBNZ Weekly Short Term Overseas Assets: 1954-1985



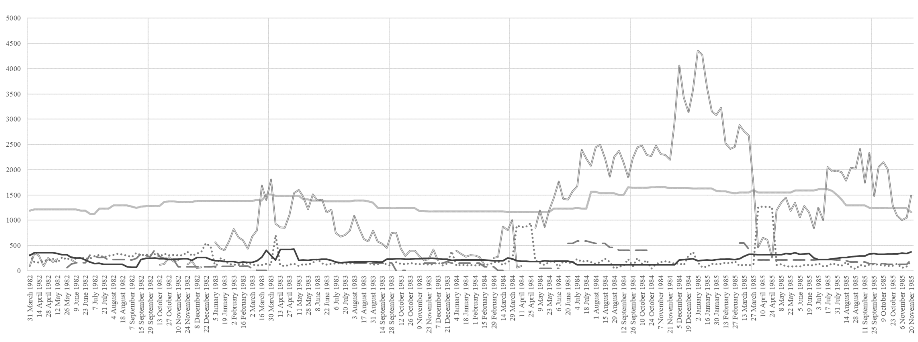
RBNZ Weekly Liabilities: 1954-1966



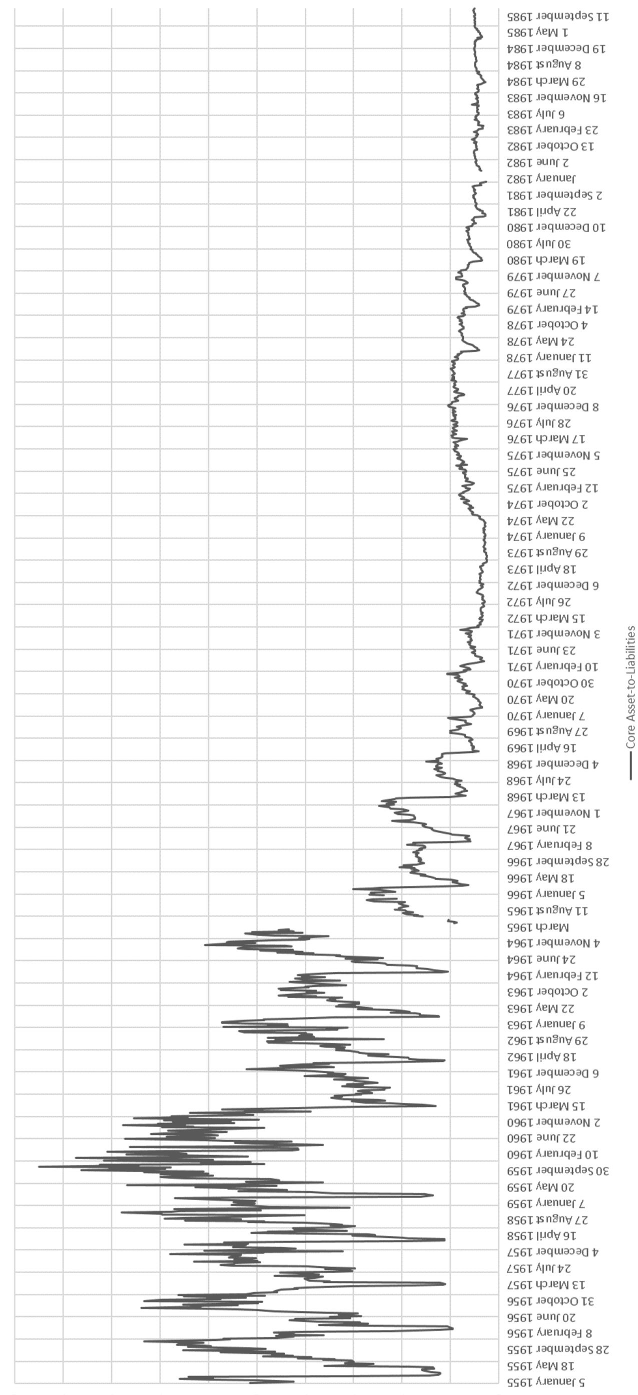
RBNZ Weekly Liabilities: 1967-1981



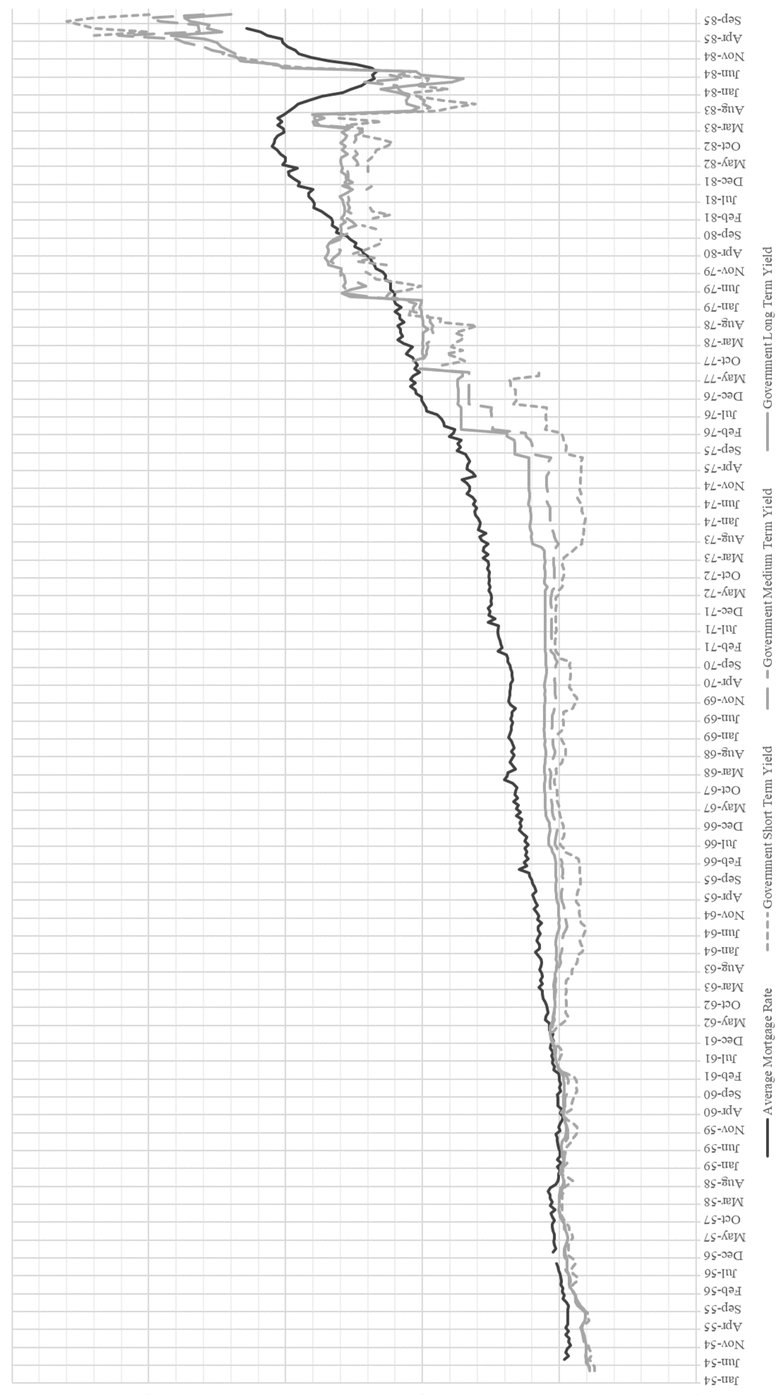
RBNZ Weekly Liabilities: 1982-1985



RBNZ Weekly Core Assets-to-Liabilities Ratio: 1955-1985



Average Mortgage and Government Yields: 1954-1985



Annual Public Debt: 1941-1966

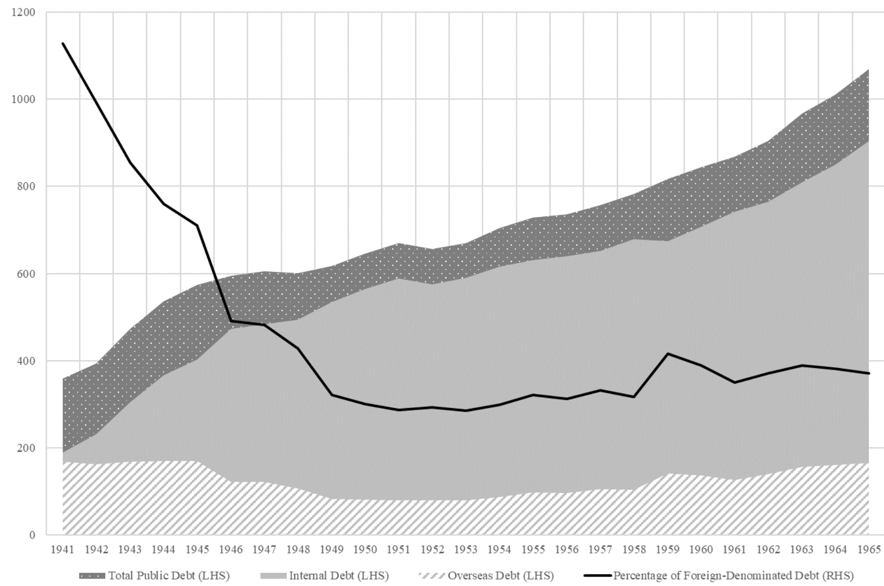


Figure D.1: Source: Department of Statistics

Annual Public Debt: 1967-85

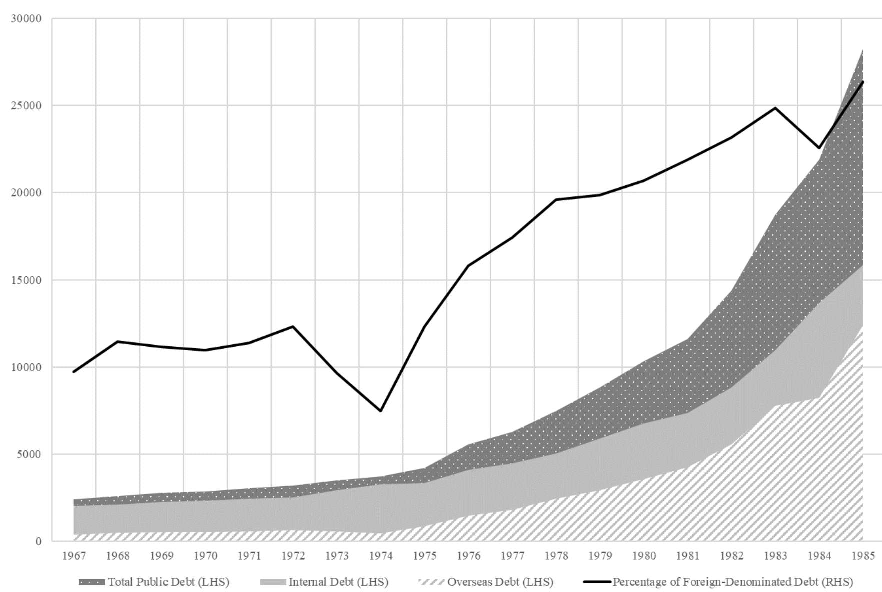
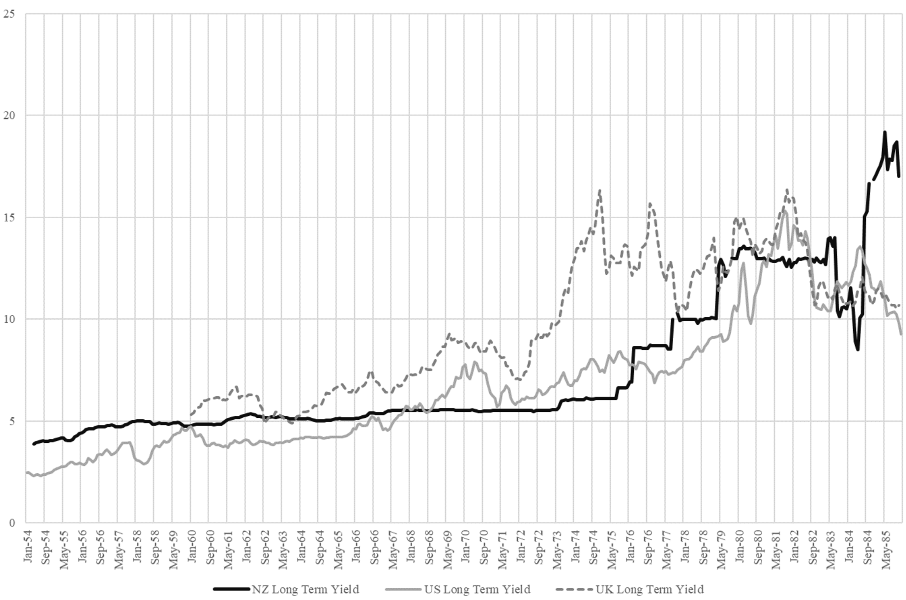
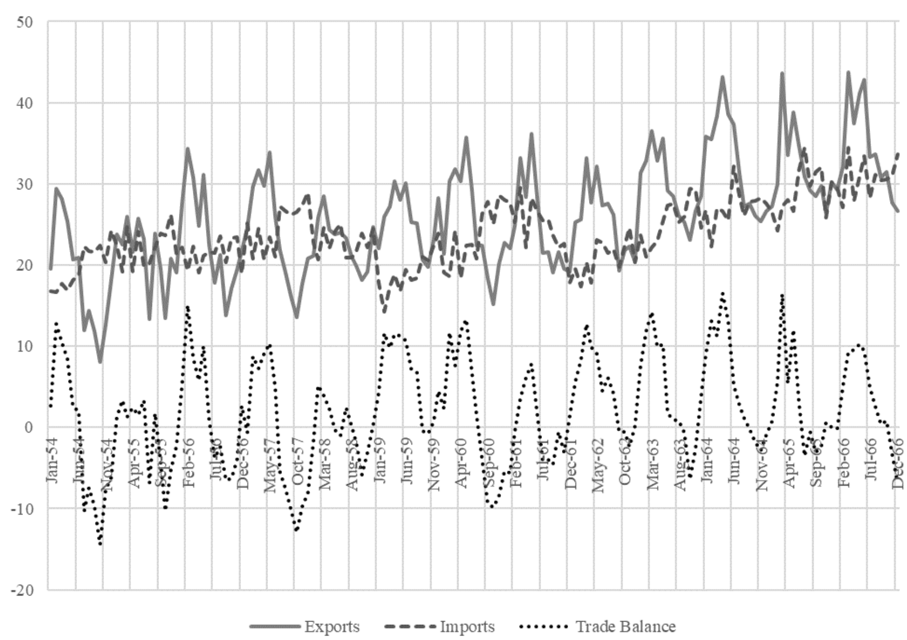


Figure D.2: Source: Department of Statistics

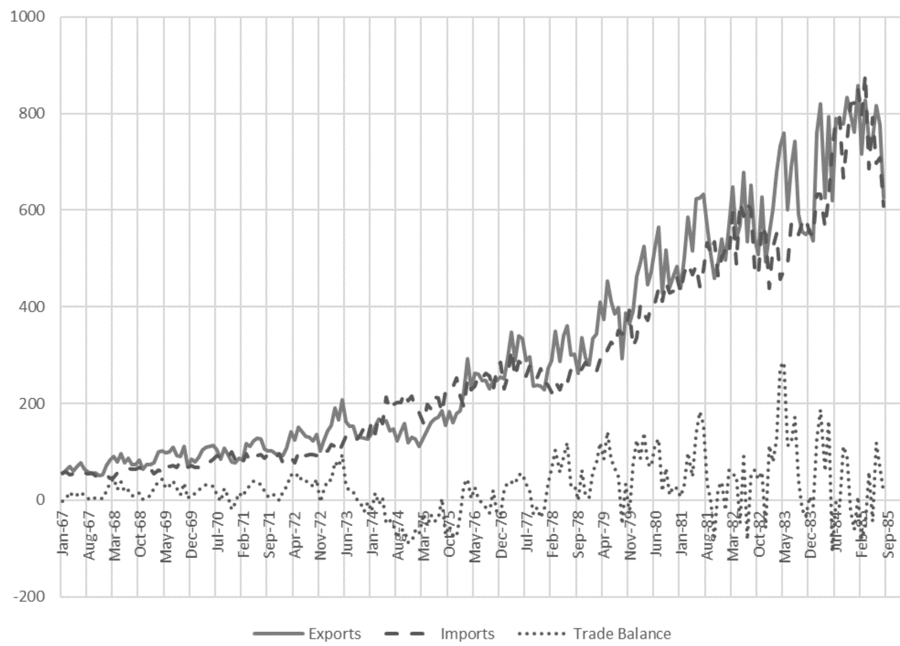
International Government Yields: 1954-1985



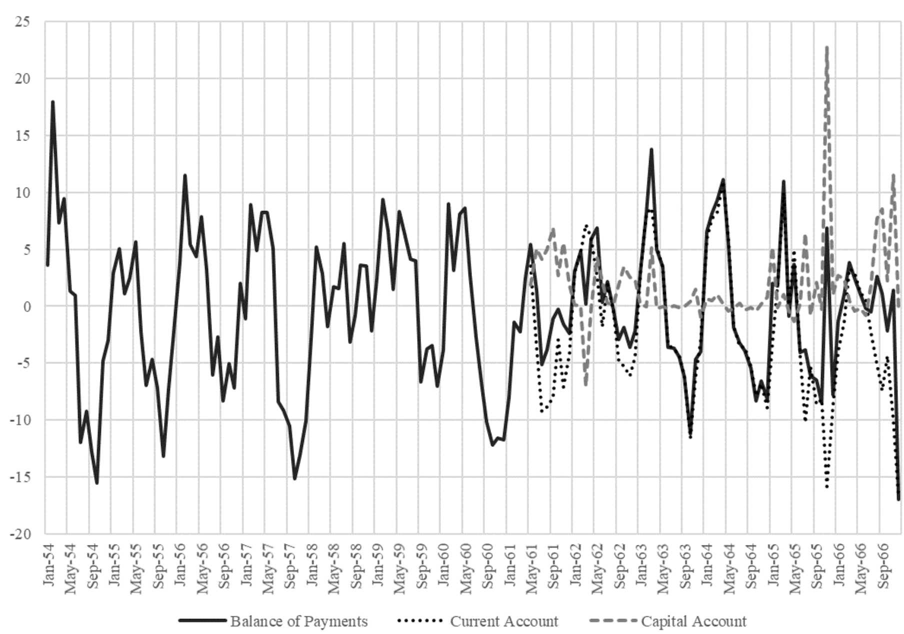
Exports, Imports, and Trade Balance: 1954-1966



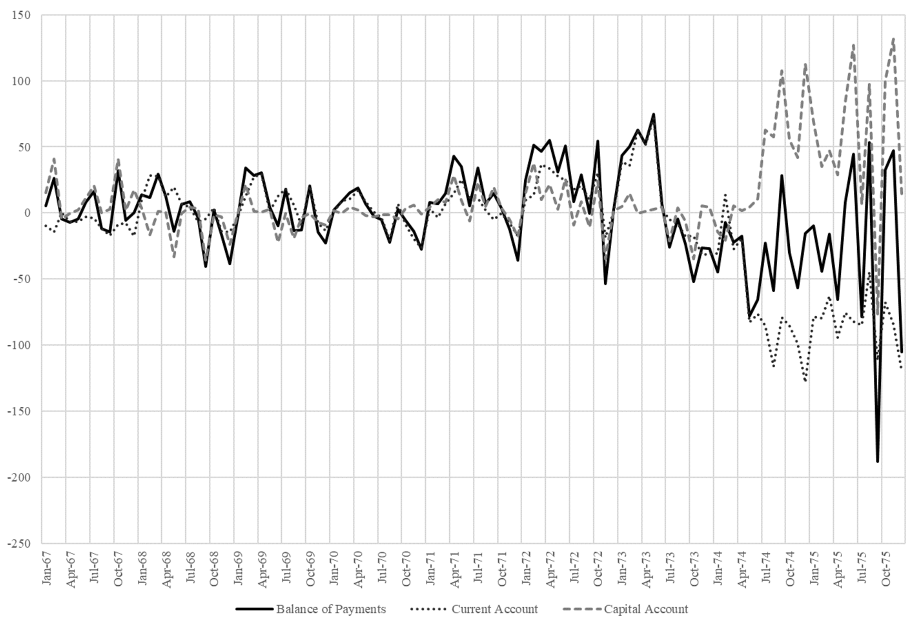
Exports, Imports, and Trade Balance: 1967-1985



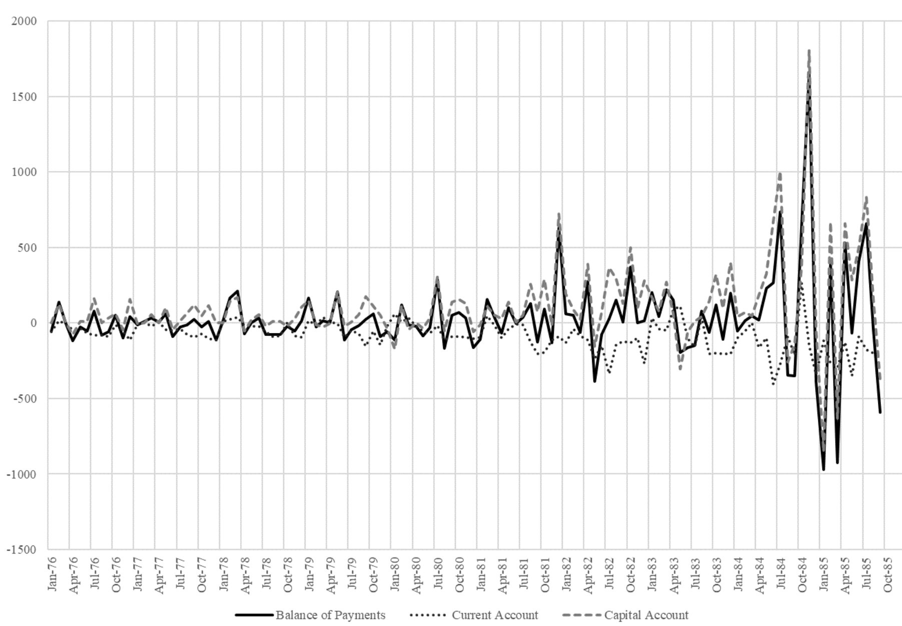
Balance of Payments: 1954-1966



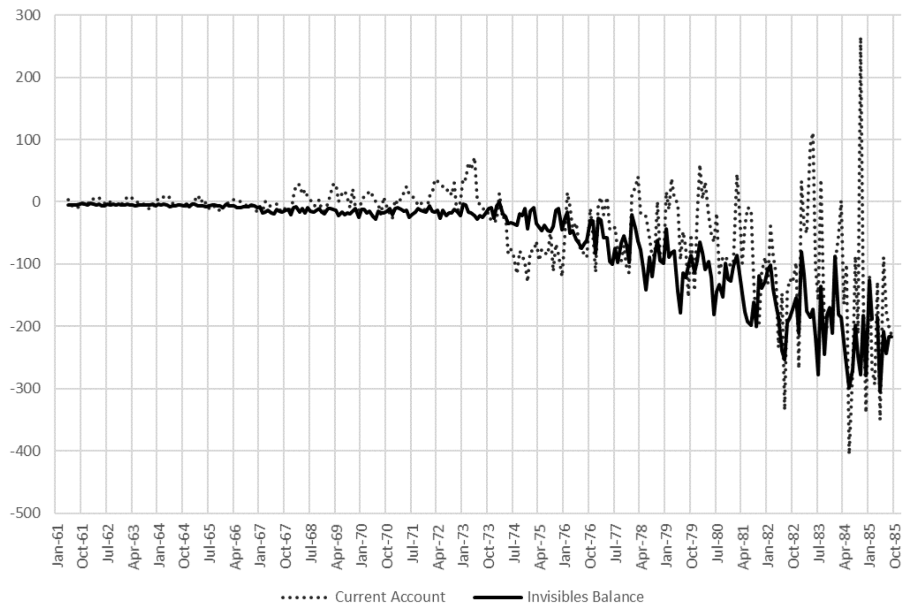
Balance of Payments: 1967-1975



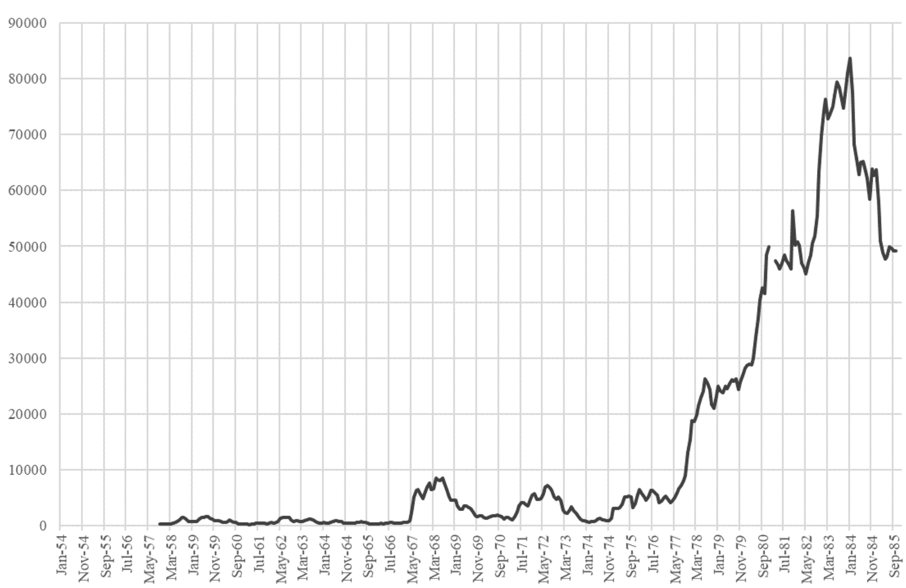
Balance of Payments: 1976-1985



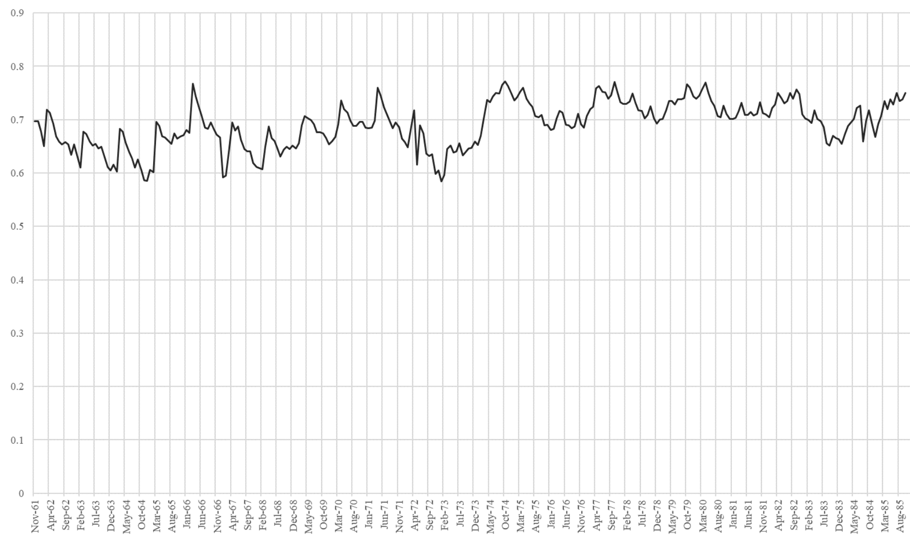
Current Account and Invisibles Balance: 1961-1985



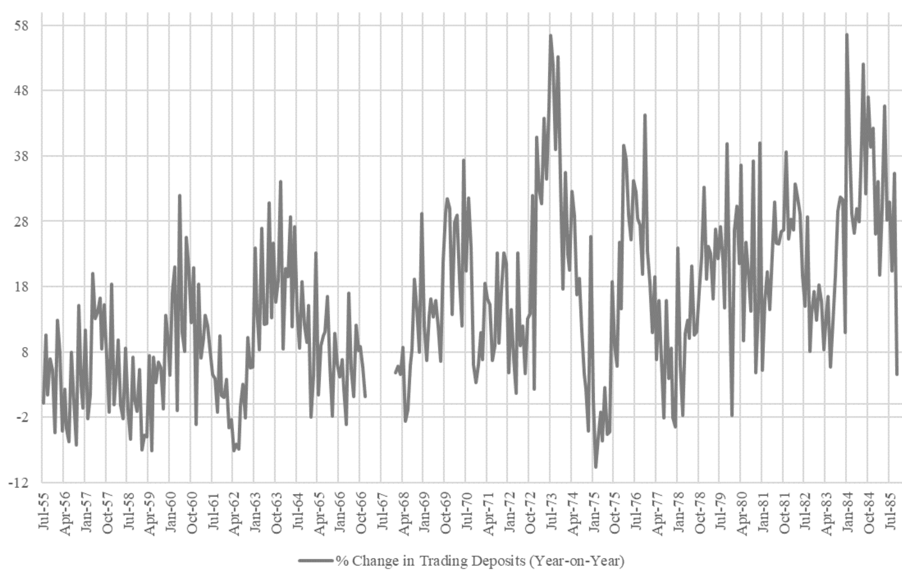
Number of Unemployed: 1957-1985



Trading Bank Lending as Portion of Lending Limits: 1961-1985



Changes in Trading Deposits: 1955-1985



Bibliography

[1] Aikman, D., Haldane, G., and Nelson, B. (2015) "Curbing the Credit Cycle." *The Economic Journal, Vol. 125, pp. 1072-1109*

[2] Adrian, T., and Liang, N. (2014) "Monetary Policy, Financial Conditions, and Financial Stability." *Federal Reserve Bank of New York Staff Report No. 690 (September 2014)*

[3] Adrian, T., and Shin, H. (2008) "Financial Intermediaries, Financial Stability, and Monetary Policy." *Federal Reserve Bank of New York Staff Report No. 346 (September 2008)*

[4] Adrian, T., and Shin, H. (2010) "The Changing Nature of Financial Intermediation and the Financial Crisis of 2007-09." *Federal Reserve Bank of New York Staff Report No. 439 (April 2010)*

[5] Agenor, P., Alper, K., and da Silva, L. (2013) "Capital Regulation, Monetary Policy, and Financial Stability." *International Journal of Central Banking, 9(3), pp. 193-238*

[6] Agur, I., and Demertzis, M. (2013) "'Leaning Against the Wind' and the Timing of Monetary Policy." *Journal of International Money and Finance, 35, pp. 179-194*

[7] Aikman, D., Giese, J., Kapadia, S., and McLeay, M. (2019) “Targeting Financial Stability: Macroprudential or Monetary Policy?" *ECB Working Paper No. 2278 (May 2019)*

[8] Aizenman, J. (1981) “Devaluation and Liberalization in the Presence of Tarriffs and Quota Restrictions." *Journal of International Economics, Vol. 11(2), p. 197-206*

[9] Ajello, A., Laubach, T., Lopez-Salido, D., and Nakata, T. (2016) “Financial Stability and Optimal Interest-Rate Policy." *Finance and Economics Discussion Series 2016-067, Washington Board of Governors of the Federal Reserve System (August 2016)*

[10] Altunbas, Y., Binici, M., and Cambacorta, L. (2017) “Macroprudential Policy and Bank Risk." *BIS Working Papers No. 646 (June 2017)*

[11] Angelini, P., Neri, S., and Panetta, F. (2012) “Monetary and Macroprudential Policies." *ECB Working Paper No. 1449 (July 2012)*

[12] Bahaj, S., and Foulis, A. (2017) “Macroprudential Policy under Uncertainty." *International Journal of Central Banking, 13(3), pp. 119-154*

[13] Behn, M., Gross, M., and Peltonen, T. (2016) “Assessing the Costs and Benefits of Capital-Based Macroprudential Policy." *ECB Working Paper Series No. 17 (July 2016)*

[14] Bernanke, B., and Gertler, M. (1995) “Inside the Black Box: The Credit Channel of Monetary Policy." *Journal of Economic Perspectives, 9(4), pp. 27-48*

[15] Blanchard, O. (2018) “On the Future of Macroeconomic Models." *Oxford Review of Economic Policy, 34(1-2), pp. 43-54*

[16] Bollard, A., and Buckle, R. (1987) *Economic Liberalisation in New Zealand.* Port Nicholson Press, Wellington

[17] Bordo, M., Meissner, C., and Stuckler, D. (2010) “Foreign Currency Debt, Financial Crises and Economic Growth: A Long-run View." *Journal of International Money and Finance, Vol. 29(4), p. 642-665*

[18] Bordo, M., Hargreaves, D., and Kida, M. (2011) “Global Shocks, Economic Growth and Financial Crises: 120 Years of New Zealand Experience." *Financial History Review, Vol. 18(3), pp. 331-355*

[19] Borio, C. (2014) “Monetary Policy and Financial Stability: What Role in Prevention and Recovery?" *BIS Working Paper No. 440 (January 2014)*

[20] Borio, C., and White, W. (2004) “Whither Monetary and Financial Stability? The Implications of Evolving Policy Regimes." *BIS Working Paper No. 147 (February 2004)*

[21] Borio, C. (2012) “The Financial Cycle and Macroeconomics: What Have We Learnt?" *BIS Working Papers No. 365*

[22] Boughton, J. (2001) *Silent Revolution: The International Monetary Fund, 1979-89* Washington, D.C., International Monetary Fund (October 2001)

[23] Buckle, R. (1987) “Sequencing and the Role of the Foreign Exchange Market." *In* Economic Liberalisation in New Zealand (1987), edited by A. Bollard and R. Buckle, Allen & Unwin Port Nicholson Press, Wellington

[24] Buiter, W. (1986) “Borrowing to Defend the Exchange Rate and the Timing and Magnitude of Speculative Attacks." *NBER Working Paper No. 1844 (February 1986)*

[25] Bruno, V., and Shin, H. (2015) “Capital Flows and the Risk-Taking Channel of Monetary Policy." *Journal of Monetary Economics, Vol. 71, pp. 119-132*

[26] Cagliarini, A., and Price, F. (2017) “Exploring the Link Between Macroeconomic and Financial Cycles." *Reserve Bank of Australia Conference: Monetary*

Policy and Financial Stability in a World of Low Interest Rates, 16-17 March 2017

[27] Calvo, G. (1978) "On the Time Consistency of Optimal Policy in a Monetary Economy." *Econometrica, 46(6), pp. 1411-1428*

[28] Calvo, G. (1998) "Capital Flows and Capital-Market Crises: The Simple Economics of Sudden Stops." *Journal of Applied Economics, Vol. 1(1), pp. 35-54*

[29] Campbell, J., Lo, A., and MacKinay, A. (1997) *The Econometrics of Financial Markets.* Princeton University Press, Princeton, NJ

[30] Caplin, A., and Leahy, J. (1994) "Business as Usual, Market Crashes, and Wisdom After the Fact." *American Economic Review, Vol. 84(3), pp. 548-565*

[31] Carney, M. (2014) "Remit for the Monetary Policy Committee." *HM Treasury, London, 19 March 2014*

[32] Carney, M. (2020) "Remit for the Monetary Policy Committee." *HM Treasury, London, 11 March 2020*

[33] Cerutti, E., Claessens, S., and Laeven, L. (2016) "The Use and Effectiveness of Macroprudential Policies." *BIS Papers No. 86, "Macroprudential Policy", pp. 95-103 (September 2016)*

[34] Chetwin, W., and Reddel, M. (2012) "Monetary policy in the Last Business Cycle: Some Perspectives." *Reserve Bank of New Zealand Bulletin, Vol. 75, pp. 3-14*

[35] Christiano, L., and Fitzgerland, T. (2003) "The Band-Pass Filter." *International Economic Review, Vol. 44, pp. 435-465*

[36] Claessens, S., Ghosh, S., and Mihet, R. (2013) "Macro-prudential Policies to Mitigate Financial System Vulnerabilities." *Journal of International Money and Finance, 39, pp. 153-185*

[37] Claessens, S., Kose, M., and Terrones, M. (2011) "Financial Cycles: What? How? When?" *IMF Working paper 11/76*

[38] Cole, H., and Kehoe, T. (2000) "Self-Fulfilling Debt Crises." *Review of Economic Studies, Vol. 67, pp. 91-116*

[39] Collard, F., Dellas, H., Diba, B., and Loisel, O. (2017) "Optimal Monetary and Prudential Policies." *American Economic Journal: Macroeconomics, 9(1), pp. 40-87*

[40] Comin, D., and Gertler, M. (2006) "Medium-term Business Cycles." *American Economic Review, Vol. 96, pp. 523-551*

[41] Corden, W. M. (1987) "Protection and Liberalization: A Review of Analytical Issues." *IMF Occasional Paper No. 54 (August 1987)*

[42] Craigie, R., and Munro, A. (2010) "Financial Sector Amplification and Credit Cycles in New Zealand." *Reserve Bank of New Zealand Bulletin, Vol. 73, pp. 15-34*

[43] Dalziel, P. (2002) "New Zealand's Economic Reforms: An Assessment." *Review of Political Economy, Vol. 14(1), pp. 31-46*

[44] De Paoli, B., and Paustian, M. (2017) "Coordinating Monetary and Macroprudential Policies." *Journal of Money, Credit and Banking, 49(2-3), pp. 319-349*

[45] Deane, R. (1981) "An Overview of Balance of Payments Policy." *In* External Economic Structure and Policy: An Analysis of New Zealand's Balance of Payments, edited by Deane, R., Nicholl, P., and Walsh, M., Reserve Bank of New Zealand, Wellington

[46] Department of Statistics (various years) *New Zealand Official Year Book* Wellington, New Zealand

[47] Dickey, A., and Fuller, W. (1979) “Distribution of the Estimators for Autoregressive Time Series with a Unit Root." *Journal of the American Statistical Association, Vol. 74, pp. 427-431*

[48] Dickey, A., and Fuller, W. (1981) “Likelihood Ratio Statistics for Autoregressive Time Serives with a Unit Root." *Econometrica: Journal of the Econometric Society, Vol. 49, pp. 1057-1072*

[49] Disyatat, P. (2010) “Inflation Targeting, Asset Prices, and Financial Imbalances: Contextualising the Debate." *Journal of Financial Stability, 6, pp. 145-155*

[50] Domanski, D., and Ng, T. (2011) “Getting Effective Macroprudential Policy On the Road: Eight Propositions." *BIS Papers No. 60*

[51] Drehmann, M., Borio, C., and Tsatsaronis, K. (2012) “Characterising the Financial Cycle: Don’t Lose Sight of the Medium Term!" *BIS Working Paper No. 380 (June 2012)*

[52] Easton, B. (1989) “From Run to Float: The Making of the Rogernomics Exchange Policy." *In* The Making of Rogernomics (1989), edited by B. Easton, Auckland University Press, Auckland

[53] Easton, B. (1997) *In Stormy Seas: The Post-War New Zealand Economy*, University of Otago Press, Wellington

[54] Easton, B. (2009) “What Happened in July 1984: And the Aftermath." *Memoir accessed at:* https://www.eastonbh.ac.nz/2009/03/what-happened-in-july-1984-and-the-aftermath/

[55] Eichengreen, B., Rose, A., and Wyplosz, C. (1996) “Contagious Currency Crises." *NBER Working Paper No. 5681 (July 1996)*

[56] Einarsson, B., Gunnlaugsson, K., Olagsson, T., and Petursson, T. (2016) “The Long History of Financial Boom-Bust Cycles in Iceland." *Central Bank of Iceland Working Paper No. 72*

[57] Endres, A., and Rogers, A. (2014) “Trade Policy and International Finance in the Bretton Woods Era: A Doctrinal Perspective with Reference to Australia and New Zealand." *History of Economics Review No. 59 (Winter), pp. 62-81*

[58] Evans, L., Grimes, A., Wilkinson, B., and Teece, D. (1995) “Economic Reform in New Zealand 1984-95: The Pursuit of Efficiency." *Journal of Economic Literature, Vol. 34(4), pp. 1856-1902*

[59] Flood, R., and Garber, R. (1984) “Collapsing Exchange-Rate Regimes: Some Linear Examples." *Journal of International Economics, Vol. 17, pp. 1-13*

[60] Frankel, J. (2005) “Contractionary Currency Crashes in Developing Countries." *NBER Working Paper No. 11508 (June 2005)*

[61] Gambacorta, L. (2009) “Monetary Policy and the Risk Taking Channel." *BIS Quarterly Review, pp. 43-53 (December 2009)*

[62] Gambacorta, L., and Signoretti, F. (2013) “Should Monetary Policy Lean Against the Wind?" *BIS Working Paper No. 418 (July 2013)*

[63] Gerlach, S., and Smets, F. (1995) “Contagious Speculative Attacks." *European Journal of Political Economy, Vol. 11., pp. 5-63*

[64] Gourio, F., Kashyap, A., and Sim, J. (2017) “The Tradeoffs in Leaning Against the Wind." *NBER Working Paper No. 23658 (August 2017)*

[65] Graeve, F., Kick, T., and Koetter, M. (2008) “Monetary Policy and Financial (In)Stability: An Integrated Micro-Macro Approach." *Journal of Financial Stability, 4(3), pp. 205-231*

[66] Graham, J., and Smith, C. (2012) “A Brief History of Monetary Policy Objectives and Independence in New Zealand." *Reserve Bank of New Zealand Bulletin , Vol. 75(1) (March 2012)*

[67] Hall, D. (2017) “Emerging from an Entrenched Colonial Economy; New Zealand Primary Production, Britain and the EEC, 1945-1975." *Palgrave Macmillan*

[68] Hall, V., and McDermott, C. (2016) “Recessions and Recoveries in New Zealand’s Post-Second World War Business Cycles." *New Zealand Economic Papers, Vol. 50, pp. 261-280*

[69] Hamilton, J. (1994) *Time Series Analysis.* Princeton University Press, Princeton, NJ

[70] Hansen, L., and Sargent, T. (2001) “Robust Control and Model Uncertainty." *The American Economic Review, 91(2), pp. 60-66*

[71] Hansen, L., and Sargent, T. (2008) *Robustness.* Princeton University Press, Princeton, NJ

[72] Hansen, L., Sargent, T., Turmuhambetova, G., and Williams, N. (2006) “Robust Control and Model Misspecification." *Journal of Economic Theory, 128, pp. 45-90*

[73] Harding, D., and Pagan, A. (2002) “Dissecting the Cycle: A Methodological Investigation." *Journal of Monetary Economics, Vol. 49, pp. 365-381*

[74] Harvey, D. (2004) “Political Dependency and Reform: Economic Gains Versus Political Pains." *Agricultural Eocnomics, Vol. 31(2-3), pp. 265-275*

[75] Hatzius, J., Hooper, P., Mishkin, F., Schoenholz, K., and Watson, M. (2010) “Financial Condition Indices: A Fresh Look After the Financial Crisis." *NBER Working Paper Np. 16150*

[76] Hawke, G. (1985) *The Making of New Zealand: An Economic History.* Cambridge University Press, New York

[77] Hawke, G., and Wigewardane, B. (1972) "New Zealand and the International Monetary Fund." *Economic Record, Vol. 48(1), pp. 92-102*

[78] Herring, R. (2018) "The Evolving Complexity of Capital Regulation." *Journal of Financial Services Research, 53(2), pp. 183-205*

[79] Hunt, C. (2009) "Banking Crises in New Zealand — an Historical Perspective." *Reserve Bank of New Zealand Bulleting Vol. 72, pp. 26-41*

[80] Hunt, C. (2013) "The Last Financial Cycle and the Case for Macro-Prudential Intervention." *Reserve Bank of New Zealand Bulletin, Vol. 76, pp. 3-16*

[81] IMF (2013) "The Interaction of Monetary and Macroprudential Policies." *IMF Policy Papers (January 2013)*

[82] IMF (1967) "New Zealand — 1966 Article XIV Consultation and Purchase Transaction." *Minutes of the Executive Board Meeting, IMF Document EBM/67/30 (May 1967)*

[83] IMF (1974) "New Zealand — Purchase Under the Oil Facility." *Communication to Members of the Executive Board, IMF Document EBS/74/380 (October 1974)*

[84] IMF (2019) "New Zealand 2019 Article IV Consultation." *IMF Country Report No. 19/303 (September 2019)*

[85] IMF-FSB-BIS (2016) "Elements of Effective Macroprudential Policies: Lessons from International Experience." *Joint Paper by IMF, FSB, and BIS (August 2016)*

[86] Johnson, R. (1987) "New Zealand Pastoral Agriculture in a More Market Environemnt." *14^{th} New Zealand Geography Conference (1987), pp. 210-215*

[87] Jorda, O., Schularick, M., and Taylor, A. (2015) "Leveraged Bubbles." *Journal of Monetary Economics, Vol. 76, pp. S1-S20*

[88] Kelsey, J. (1997) *The New Zealand Experiment: A World Model for Structural Adjustment?* Auckland University Press and Bridget Williams Books, Auckland

[89] Knight, F. (1921) *Risk, Uncertainty and Profit.* New York: Harper.

[90] Kockerols, T., and Kok, C. (2019) "Leaning Against the Wind: Macroprudential Policy and the Financial Cycle." *ECB Working Paper No. 2223 (January 2019)*

[91] Kouri, P. (1976) "The Exchange Rate and the Balance of Payments in the Short Run and in the Long Run: A Monetary Approach." *The Scandinavian Journal of Economics, Vol. 78(2), pp. 280-304*

[92] Krugman, P. (1979) "A Model of Balance-of-Payments Crises." *Journal of Money, Credit and Banking, Vol. 11(3), pp. 311-325*

[93] Krugman, P. (1999) "Balance Sheets, the Transfer Problem, and Financial Crises." *International Tax and Public Finance, Vol. 6, pp. 459-472*

[94] Krznar, I., and Matheson, T. (2017) "Financial and Business Cycles in Brazil." *IMF Working Paper WP 17/12*

[95] Lim, C., Columna, F., Costa, A., Kongsamut, P., Otani, A., Saiyid, M., Wezel, T., and Wu, X. (2011) "Macroprudential Policy: What Instruments and How to Use Them? Lessons from Country Experiences" *IMF Working Paper No. WP/11/238 (October 2011)*

[96] Lucas, R., and Stokey, N. (1983) "Optimal Fiscal and Monetary Policy in an Economy Without Capital." *Journal of Monetary Economics, 12(1), pp. 55-93*

[97] Malikane, C., and Semmler, W. (2008) "Asset Prices, Output and Monetary Policy in a Small Open Economy." *Metroeconomica, 59(4), pp. 666-686*

[98] McDonald, C. (2015) "When is Macroprudential Policy Effective?" *Reserve Bank of New Zealand Discussion paper No. DP2015/06 (November 2015)*

[99] Meon, P. (2001) "A Model of Exchange Rate Crises with Partisan Governments." *Journal of Macroeconomics, Vol. 23(4), pp. 517-535*

[100] Meon, P., and Rizzo, J. (2002) “The Viability of Fixed Exchange Rate Commitments: Does Politics Matter? A Theoretical and Empirical Investigation." *Open Economies Review, Vol. 13(2), pp. 111-132*

[101] Miranda-Aggripino, S., and Rey, H. (2015) “US Monetary policy and the Global Financial Cycle." *NBER Working Paper No. 21722*

[102] Morris, S., and Shin, H. (1998) “Unique Equilibrium in a Model of Self-Fulfilling Currency Attacks." *The American Economic Review, Vol. 88(3), pp. 587-597*

[103] Neugart, M. (2003) “Interest Groups, Enlargement of the EMU, and Labor Market Reform." *In* Institutional Conflicts and Complementarities: Monetary Policy and Wage Bargaining Institutions in the EMU, edited by R. Franzese, P. Mooslechner, and M. Schuerz, Kluwer, Dortrecht

[104] Obstfeld, M. (1994) “The Logic of Currency Crises." *NBER Working Paper No. 4640 (February 1994)*

[105] Obstfeld, M. (1996) “Models of Currency Crises with Self-Fulfilling Features." *European Economic Review, Vol. 40(3-5), pp. 1037-1047*

[106] Quigley, N. (1992) “Monetary Policy and the New Zealand Financial System: An Historical Perspective." *In* Monetary Policy and the New Zealand Financial System, 3rd Edition (1992), RBNZ

[107] RBNZ (1984) “Memorandum for the Minister of Finance: Foreign Exchange Situation." *Wellington, New Zealand (June 1984), available as a submission to the “Public Expenditure Committee 1984: Report on Inquiry into Devaluation" [1984-1985] I AJHR 12c*

[108] RBNZ (1985) “The Abolition of Exchange Controls." *Reserve Bank of New Zealand Bulletin, Vol. 48(10) (October 1985)*

[109] RBNZ (2018) “New Zealand Economic and Financial Chronology 2014-1982." *Retrieved from https://www.rbnz.govt.nz/about-us/nz-economic-and-financial-chronology*

[110] Reddell, M., and Sleeman, C. (2008) “Some Perspective on Past Recessions." *Reserve Bank of New Zealand Bulletin, Vol. 71, pp. 5-21*

[111] Reinhart, C., and Rogoff, K. (2009) *This Time Is Different: Eight Centuries of Financial Folly.* Princeton University Press: Princeton, NJ

[112] Rey, H. (2016) “International Channels of Transmission of Monetary policy and the Mundellian Trilemma." *IMF Economic Review, Vol. 64, pp. 6-35*

[113] Roisland, O. (2017) “On the Interplay between Monetary Policy and Macroprudential Policy: A Simple Analytical Framework." *Norges Bank Research Working Paper No. 18 (October 2017)*

[114] Roper, B. (1992) “Business Political Activism and the Emergence of the New Right in New Zealand, 1975 to 1987." *Political Science, Vol. 44(2), pp. 1-23*

[115] Rother, B. (2009) *The Determinants of Currency Crises: A Political-Economy Approach.* Palgrave MacMillan, Hampshire

[116] Salant, S. and Henderson, D. (1978) “Market Anticipations of Government policies and the Price of Gold." *Journal of Political Economy, Vol. 86(4), pp. 627-648*

[117] Schularick, M., and Taylor, A. (2012) “Credit Booms Gone Bust: Monetary Policy, Leverage Cycles, and Financial Crises, 1870-2008." *American Economic Review, 102(2), pp. 1029-1061*

[118] Schuler, Y., Hiebert, P., and Peltonen, T. (2015) “Characterising the Financial Cycle: A Multivariate and Time-Varying Approach." *European Central Bank Working Paper No. 1846*

[119] Shatz, H., and Tarr, D. (2000) “Exchange Rate Overvaluation and Trade Protection: Lessons from Experience." *The World Bank (February 2000)*

[120] Singeton, J. (2006) *Innovation and Independence: The Reserve Bank of New Zealand 1973-2002.* Auckland University Press, Auckland, New Zealand

[121] Smets, F. (2014) “Financial Stability and Monetary Policy: How Closely Linked?" *International Journal of Central Banking, 10(2), pp. 263-300*

[122] Stein, J. (2013) “Overheating in Credit Markets: Origins, Measurement, and Policy Responses." *Speech at the “Restoring the Household Financial Stability after the Great Recession: Why Household Balance Sheets Matter" Research Symposium, Federal Reserve Bank of St. Louis (7 February 2013)*

[123] Stiglitz, J. (2018) “Where Modern Macroeconomics Went Wrong." *Oxford Review of Economics Policy, 34(1-2), pp.70-106*

[124] Stremmel, H. (2015) “Capturing the Financial Cycle in Europe." *European Central Bank Working Paper No. 1811*

[125] Strohsal, T., Proano, C., and Wolters, J. (2017) “Assessing the Cross-Country Interaction of Financial Cycles: Evidence From a Multivariate Spectral Analysis of the US and the UK." *IMK Macroeconomic Policy Institute Working Paper No. 182*

[126] Svensson, L. (2014) “Inflation Targeting and Leaning Against the Wind: A Case Study." *International Journal of Central Banking, 10(2), pp. 103-114*

[127] Svensson, L. (2016) ““Cost-Benefit Analysis of Leaning Against the Wind: Are Costs Larger Also with Less Effective Macroprudential Policy?" *IMF Working Paper No. 16/3 (January 2016)*

[128] Svensson, L. (2017) “Leaning Against the Wind: Costs and Benefits, Effects on Debt, Leaning in DSGE Models, and a Framework for Comparison of Results." *International Journal of Central Banking, 13(3), pp.385-408*

[129] Tallarini, T. (2000) "Risk-sensitive Real Business Cycles." *Journal of Monetary Economics, 45(3), pp. 507-532*

[130] Terrier, G., Valdes, R., Tovar, C., Chan-Lay, J., Fernandez-Valdovinos, C., Garcia-Escribano, M., Medeiros, C., Tang, M., Martin, M., and Walker, C. (2011) "Policy Instruments To Lean Against The Wind In Latin America." *IMF Working Paper No. WP/11/159 (July 2011)*

[131] Ueda, K., and Valencia, F. (2014) "Central Bank Independence and Macroprudential Regulation." *Economic Letters, 125, pp. 327-330*

[132] White, W. (2009) "Should Monetary Policy "Lean or Clean"?" *Federal Reserve Bank of Dallas Working Paper No. 34 (August 2009)*

[133] Woodford, M. (2012) "Inflation Targeting and Financial Stability." *NBER Working Paper No. 17967 (April 2012)*

[134] Wooding, P. (1987) "Liberalising the International Trade Regime." *In* Economic Liberalisation in New Zealand (1987), edited by A. Bollard and R. Buckle, Allen & Unwin Port Nicholson Press, Wellington